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ABSTRACT

A spacer is disclosed for positioning a sheet in a spaced relationship relative to framework that supports the sheet in use. The spacer is elongate and extends between first and second opposite ends. The spacer comprises one leg only that is located at the first end. The leg is arranged for positioning the first end in a spaced relationship relative to the framework.

SPACER

TECHNICAL FIELD

A spacer is disclosed that can be attached to an existing framework (e.g. to the purlins, studs, etc. of roofing and wall framework, etc.). The spacer enables sheets (such as roof or wall sheets), panels, board, cladding, etc. (hereafter collectively referred to as "sheets") to then be attached to the framework via the spacer. The spacer functions, inter alia, to provide space for insulation placed over or against the framework and underneath the sheets. The spacer may prevent such insulation from being unduly compressed or crushed. The spacer may also provide a cavity for services, etc.

BACKGROUND ART

Large roof areas, such as on shopping centres or other large buildings, typically comprise steel girders to act as beams. Framework (e.g. roof purlins) may be fixed across the beams and at spaced intervals. A safety mesh is typically attached to the framework. Roof sheets are then screwed into the framework or attached by other known means such as via a clip lock mechanism. It is often a requirement to provide suitable insulation in the roof area. Insulating material in roll form is laid over the framework and the roof sheets are then attached. The insulating material can comprise aluminium foil and PE bubble insulation, glasswool insulation and the like.

Insulation may also be employed within external or internal walls in a building. Again, wall sheets, panels, board, etc. are then fixed with respect to the wall framework (such as to the studs, posts, plates, etc.), thereby retaining the insulation within the wall cavity.

A disadvantage with the conventional approach is that the insulation material is compressed between the framework and the sheets. For insulation material to achieve its proper insulating rating it needs to be in its recovered form. Compressed or crushed insulation reduces insulation efficiency.

Roofing spacers are known in the art that are employed between the roofing framework and the roof sheets so as to prevent insulation material from being compressed. Examples are shown in each of AU 2014213575; WO2008/128284; AU 2015246065; and A2015218172. A problem with the use of such spacers can arise when installing roof sheeting at height. Here, a roof sheet installer can be subjected to wind and air movement, roof slopes, etc. In addition, if the spacer is difficult to position and affix, this can lead to occupational hazards. Further, if it is then difficult to attach roof sheets to the spacer, this can also lead to hazards, and can slow down roof sheet installation time.

The above references to the background art do not constitute an admission that the art forms part of the common general knowledge of a person of ordinary skill in the art. The above references are also not intended to limit the application of the spacer as disclosed herein.

SUMMARY

Disclosed herein is a spacer for positioning a sheet in a spaced relationship relative to framework that supports the sheet in use. The spacer can space the sheets from the framework so as to e.g. prevent insulation material from being compressed. Whilst the spacer finds particular application in roofing applications (i.e. to position a roof sheet in a spaced relationship relative to roofing framework), it should be understood that the spacer can be employed in a variety of other sheet-spacing applications including, for example, the spacing of sheets that are affixed with respect to internal and external walls, etc. As an alternative or additional to preventing insulation material from being compressed, the spacer may function to provide a cavity within a roof, wall, etc. (i.e. between the sheets and framework). This cavity may be employed to accommodate services such as electrical, cabling, wiring, water, gas, etc.

The spacer as disclosed herein is elongate and extends between first and second opposite ends. The spacer comprises one leg only that is located at the spacer first end. The leg comprises a wall that defines an upper distal end. This leg is arranged for positioning the first end in a spaced relationship relative to the framework.

The provision of a spacer with just one leg may seem counter-intuitive, however, surprisingly because the spacer can work cooperatively with a like, adjacent spacer, the one leg can simultaneously support the two adjacent spacers. In other words, the leg of a given spacer can support the second end of an adjacent spacer, and so on along a framework. Further, because the leg can also support the adjacent spacer, this can result in insulation being less compressed in use and/or can provide the afore-mentioned cavity. Thus, the one leg may support adjacent or overlapping ends of adjacent spacers.

In this regard, in some embodiments, the spacer may be arranged for receiving thereat a second end of a like spacer, whereby the leg is able to support the second end of the like spacer in the spaced relationship relative to the framework. When it is stated herein that the spacer receives thereat a second end of a like spacer, it is intended that this like spacer second end may be received at the spacer first end, or may be received somewhere along the spacer (i.e. intermediate its first and second ends). In the latter case, the adjacent spacers can overlap. This ability to overlap has certain benefits, including enabling spacer stackability, and also allowing a shortened overall length of spacers (e.g. at the end of a run of spacers located at a framework, as set forth hereafter).

The leg extends from the first end in a manner that defines an opening at the spacer first end. The second end of the like spacer may be received in the opening, whereby the spacers may be arranged end-to-end. The second end of the like spacer is able to be received in the opening to locate at and pivot on the upper distal end, such that the leg is able to support the second end of the like spacer in the spaced relationship relative to the framework. By enabling the second end of the like spacer to be received therein, the opening can allow for spacer installation in a relatively quick, safe, reliable, repeatable and easy manner, in that the opening can facilitate rapid spacer-to-spacer alignment. Each such opening can also allow for multiple like spacers to be progressively installed in series across the framework, and for sheets to thus be sequentially installed. Each such installed sheet can also allow e.g. an installer to stand thereon and to be supported thereby as a next spacer is placed in the opening of an installed spacer, and then positioned at the framework, and so on.

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In some embodiments, the upper distal end of the leg of the spacer may comprise an edge that can support the second end of the like spacer during pivoting of the like spacer and when in the spaced relationship relative to the framework.

In some embodiments, the spacer may comprise an elongate web and opposing elongate walls that each extend from a respective elongate side of the web. The leg may extend from (e.g. be connected to) each of the opposing elongate walls. The elongate web and opposing elongate walls may give the spacer the form of an inverted channel section (e.g. that may be stacked, overlapped, etc.). Such a channel profile may also provide enhanced structural properties to the spacer, even when formed of a relatively light gauge sheet material (e.g. galvanised steel sheet, aluminium sheet, etc.).

In some embodiments, the opposing elongate walls may each extend so as to diverge from a respective elongate side of the web. Again, this divergence can enhance spacer stackability and overlap, but can also provide a shape to the opening that can facilitate the receipt and guidance therein of the second end of the like spacer in use.

In some embodiments, the opposing elongate walls may each taper towards a distal end of the web. Such tapering can contribute a shape to the second end that facilitates its receipt and guidance into the opening of an adjacent spacer in use.

In some embodiments, at the second end, an end of the web may have one or more notches formed thereinto (e.g. typically at least a centrally arranged notch). The one or more notches may be arranged to facilitate insertion of the second end into the opening at the first end of the adjacent spacer in use (e.g. they may enable deformation of the second end during insertion). This can result in an interference fit once the second end has been so inserted. The interference fit can provide integrity in the spacer-to-spacer connection during fastening of the spacer to the framework.

In some embodiments, each of the elongate walls further comprises an elongate flange that extends for a substantial length of its respective elongate wall. Each flange may project laterally outwards of its respective elongate wall. Whilst the flanges can provide further structural integrity to the spacer, as set forth hereafter, they can also function to enable attachment of the one leg to the spacer. In addition, the flanges can rest on an underlying insulation layer that is positioned at the framework.

In some embodiments, the leg may comprise a leg web. Opposing leg walls may each extend from a respective side of the leg web. Further, leg flanges may each extend for a substantial length of its respective leg wall. Each leg flange may project laterally outwards of its respective leg wall. The leg flanges can provide further structural integrity to the leg. In addition, the leg may have a similar "channel" profile to a remainder of the spacer.

Further, the leg flanges may be joined to respective elongate wall flanges, with the opening then being located between these joins. By joining the leg only via the wall flanges and respective leg flanges, this can maximise the size of the opening, to better facilitate insertion of the second end of a like spacer in use.

In some embodiments, each of the joins comprises a respective gusset formed therein. Such a gusset can function to strengthen the leg joint at either side of the spacer. This may help to prevent the leg from collapsing in use (e.g. under load).

In some embodiments, each elongate flange may further comprise one or more discrete support formations therein that are adjacent to the second end. These support formations may e.g. take the form of a pair of discrete, spaced dimples that are press-formed into each flange. Each support formation may be arranged to locate the spacer second end at a starter support (as set forth hereafter). The starter support may be pre-arranged at (e.g. pre-secured to) the framework, or it may first be located at the spacer second end, and then secured to the framework. The starter support can take the place of a leg for a first-to-be-positioned spacer at its second end. The starter support may take the form of a starter saddle onto which the second end of the spacer can locate and at which it may be supported against lateral movement.

In some embodiments, one or more formations may be provided in a web of the spacer. Each such formation may be adapted to enable a sheet to be secured with respect to the spacer.

In one such embodiment, the one or more formations may comprise one or more apertures through the web. The one or more apertures configured for enabling a clip-bearing assembly to be arranged at and secured to the web. Such a clip-bearing assembly can facilitate rapid securing of a sheet to the spacer (e.g. the clip-bearing assembly may be adapted to the push-fitting of roof sheets with respect to a framework).

The clip-bearing assembly may be arranged to be secured to the web via one or more fasteners. The one or more fasteners may optionally each be configured so as to pass through to the framework to secure both the clip-bearing assembly and the spacer to the framework. This can speed up installation, and can also decrease the overall number of fasteners required.

In another such embodiment, the one or more formations may comprise one or more deformations in the web. The one or more deformations may be additional or alternative to the one or more apertures. Each such deformation can enable a respective fastener to pass through the spacer web (e.g. each deformation may take the form of a pilot point or a pilot hole for a self-tapping or self-drilling fastener). Again, the one or more fasteners may each be able to pass through to the framework to secure the spacer to the framework. Thus, when a given sheet is to be secured to the spacer via one or more fasteners, each such fastener may pass through the sheet, through a respective deformation, and through to the framework. Again, this can speed up installation, and decrease the overall number of fasteners required.

Thus, as set forth above, the spacer may be configured such that a lesser number of separate fasteners may be required for spacer and sheet installation.

In some embodiments, at least one of the apertures is elongate. The at least one elongate aperture may comprise a tab that is located at an end of the elongate aperture. The tab may project away from the web. The tab may be adapted for engaging with the clip-bearing assembly. In this regard, it may act as a stop for the clip-bearing assembly in use. Thus, the tab can function to appropriately locate and help to secure the clip-bearing assembly to the elongate member web in use.

In some embodiments, one or more spacer formations may be formed in the spacer. Each spacer formation may be arranged to enable the spacer to be spaced with respect to a like spacer when the spacers are stacked. The spacer formations may be formed in the web and/or opposing walls of the spacer and may be such as to extend into a channel of the spacer as defined by the web and opposing walls. The one or more spacer formations can function as packing/storage aids, by spacing adjacent stacked spacers, thereby preventing stacked spacers from nesting too tightly during storage and transport (i.e. and thereby fastening to each other). Such spacer formations can also function to allow adequate ventilation between stacked spacers, mitigating corrosion of the spacers in storage.

Also disclosed herein is a spacer system for positioning a sheet in a spaced relationship relative to framework that supports the sheet in use. The system comprises an elongate spacer that extends between first and second opposite ends. The spacer comprises a leg that is located at the first end and arranged for positioning the first end in a spaced relationship relative to the framework. The spacer may be otherwise as set forth above.

The system also comprises a clip-bearing assembly to which the sheet is able to be secured. The clip-bearing assembly is arranged to be secured to the spacer. The clip-bearing assembly may be otherwise as set forth above. In this regard, when the clip-bearing assembly is secured to the sheet, and when the clip-bearing assembly is also secured to the spacer, the sheet is secured to the spacer.

The system further comprises one or more fasteners. Each fastener is adapted (e.g. it has a length and configuration) such that it is able to pass through to the framework to secure the clip-bearing assembly to the spacer, and to secure both the clip-bearing assembly and the spacer to the framework.

Thus, the spacer system can be configured such that, when securing the spacer to the framework, the clip-bearing assembly can simultaneously be secured to the spacer (i.e. each fastener can perform both roles). This can eliminate a separate securement step, and thus speed up installation. Once both spacer and clip-bearing assembly are secured to the framework, the sheet can then be readily secured (e.g. push-fit) onto the clip-bearing assembly.

Also disclosed herein is a method for forming a spacer as set forth above. The method as disclosed herein can enable the spacer to be formed from a single sheet of material (e.g. from a single "blank"). The sheet material may comprise a suitable metal (e.g. galvanised steel sheet, aluminium sheet, etc.).

The method comprises bending and/or folding a section of sheet material to define the elongate spacer as extending between the first and second opposite ends. The method also comprises bending the elongate spacer at the first end so as to form the leg.

In other words, the same sheet can be used to form both the spacer and leg. The leg may thus be integrally formed with the spacer. This can considerably simplify spacer manufacture, and hence reduce its cost to manufacture.

In some embodiments, prior to bending and/or folding, the section of sheet material may have a discrete cut formed through the sheet. The discrete cut may be located in the section such that it is adjacent to the first end once the section of sheet material has been bent and/or folded to define the spacer as extending between the first and second ends. The section of sheet material may also be bent adjacent to the discrete cut so as to form the leg. Thus, the discrete cut may enable such further bending and may also define an opening at the first end of the resultant elongate spacer. The discrete cut may be further configured so as to define the opening in a manner whereby it is able to receive therein the second end of an adjacent, like elongate spacer.

In some embodiments, the discrete cut may be formed in the sheet in a manner such that, once the leg has been formed in a first spacer, an in-use upper end of the leg is located such that, when a second spacer is located at and supported on the leg upper end, the first and second spacers are generally spaced to the same extent from the framework. As above, such an arrangement can also facilitate sheet installation and spacer-to-spacer alignment in use.

In some embodiments, the method may further comprise bending and/or folding the section of sheet to define the web and to define the opposing elongate walls that extend between the spacer first and second ends, i.e. as set forth above. This bending and/or folding may also define the opposing elongate flanges and leg flanges, i.e. as set forth above.

In some embodiments, the method may further comprise deforming and/or cutting the sheet to define the one or more formations/deformations therein (e.g. to form/cut the one or more apertures through, and/or the one or more deformations in, the web, etc. of the spacer).

Also disclosed is a method for arranging a plurality of spacers. Each spacer is as set forth above. The plurality of spacers can be arranged to enable positioning of one or more sheets in a spaced relationship relative to framework that supports the sheet(s) in use. The method for arranging the plurality of spacers can make use of the spacer configuration which enables alignment of spacers end-to-end across the framework (e.g. along a roof purlin or a wall stud).

The method comprises arranging a first spacer relative to the framework. The leg of the first spacer can locate at the framework (e.g. above a roof purlin, or at a wall stud) and can maintain a spaced relationship of the first spacer first end relative thereto. For a very first spacer, the starter support (i.e. as set forth above) can be employed to support the second end of that very first spacer.

In this regard, in some embodiments, prior to arranging the first spacer, the starter support may be arranged to locate at the framework, or may be arranged at the second end of the first spacer. The starter support can support the second end of the first spacer in the spaced relationship above the framework.

The method also comprises arranging a second spacer such that the second end of the second spacer is located at the first spacer. Again, it is intended that this like spacer second end may be received at the spacer first end (e.g. in the opening), or it may be received somewhere along the spacer (i.e. intermediate its first and second ends). In the latter case, the adjacent spacers can overlap. As set forth above, this ability to overlap has certain benefits, including spacer stackability, but by also allowing a shortened overall length of spacers - e.g. at the end of a run of spacers located at a framework.

The method further comprises pivoting the second spacer around its second end until the leg of the second spacer locates at the framework.

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As above, such an installation method can result in a quick, safe, reliable and easy methodology, and can facilitate rapid spacer-to-spacer alignment.

In some embodiments, prior to arranging the second spacer, the first spacer may be secured to the framework by one or more fasteners. This securement can then enable a sheet to be secured to the first spacer. An installer may e.g. then stand safely and securely on this sheet when installing the next spacer, and so on across the framework.

In some embodiments, the one or more fasteners may be arranged to simultaneously secure a clip-bearing assembly to the first spacer.

In other embodiments, the one or more fasteners may be arranged to simultaneously secure a sheet to the first spacer.

In some embodiments, once the second spacer has been arranged at the framework, a third spacer may be arranged such that the second end of the third spacer is located at the second spacer. The third spacer may then be pivoted around its second end until the leg of the third spacer locates at the framework. This procedure can be repeated along the framework (e.g. along a given purlin or stud), until the framework has been spanned by a number of spacers arranged end-to-end.

In some embodiments, the sheets may be arranged at and secured to the plurality of spacers that are secured to the framework (e.g. immediately after a given one or set of spacers has been secured). Alternatively, the sheets may be secured later, i.e. once the framework has been spanned by the multiple spacers.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a top perspective view of a spacer 100 in accordance with a first embodiment.

Figure 2 is an underside perspective view of the spacer 100.

Figure 3 is an enlarged top view detail of the spacer 100.

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Figure 4 is another enlarged top view detail of the spacer 100.

Figure 5 is an enlarged view of a second “male” end 120 of the spacer 100.

Figure 6 is an enlarged view of a first opposite “female” end 130 of the spacer 100.

Figure 6A is a schematic view of a starter saddle 200.

Figure 6B illustrates the starter saddle 200 of Figure 6A in use.

Figure 6C is a perspective view of the framework, including purlins P and safety mesh M.

Figure 7 is a first top perspective view of two spacers 100 and 100A in a partially inter-connected configuration.

Figure 8 is a second top perspective view of two spacers 100 and 100A in an inter-connected configuration.

Figure 9 is a side schematic view of two spacers 100 and 100A in a partially inter-connected configuration, similar to Figure 7, during use in e.g. a roofing system.

Figures 10A to 10C illustrate side schematic views of respective roofing systems having two spacers 100 and 100A in an inter-connected configuration, similar to Figure 8, during use in the respective roofing systems.

Figures 10D & 10E illustrate spacers in use, with roof sheets attached to roof-clip bearing assemblies mounted on the spacers.

Figure 11 is a perspective view of a spacer 100’ in accordance with another embodiment.

Figures 12 to 15 respectively show side, top, bottom and end views of the spacer 100’ of Figure 11, with Figure 15A showing in perspective a detail of the male (tongue) end of the spacer 100’, and with Figure 15B showing in perspective a

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detail of the male (tongue) end of the spacer 100', where the degree of taper has been reduced compared to Figure 15A.

Figures 16 & 17 respectively show enlarged perspective details of a tongue 140" of spacer 100" in accordance with another embodiment.

Figures 18 & 19 respectively show enlarged perspective details of a female end of the spacer 100".

Figures 20 and 21 respectively show an in-use top perspective detail and an enlarged detail of the spacer 100" in combination with a roof clip assembly A.

Figure 22 is a schematic view of embodiments of various roof clip-bearing assemblies A to G.

Figures 23 & 23A respectively show perspective and plan views of a spacer 100^{IV} in accordance with another embodiment, with gussets G formed at the leg joint.

Figures 24 & 24A respectively show perspective and plan views of the spacer 100', but with gussets G formed at the leg joint.

Figures 25 & 25A respectively show a perspective view and an enlarged detail of a spacer 100^{V} in accordance with another embodiment, with spacer formations D formed in the web and opposing side walls.

Figures 26 & 26A respectively show perspective and plan views of a spacer 100^{VI} in accordance with another embodiment, with location dimples formed on the elongate flanges, proximal the male end.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

In the following detailed description, reference is made to accompanying drawings which form a part of the detailed description. The illustrative embodiments described in the detailed description, depicted in the drawings and defined in the claims, are not intended to be limiting. Other embodiments may be utilised and other changes may be made without departing from the spirit or scope of the subject matter presented. It will be readily understood that the aspects of the present disclosure, as generally described herein and illustrated in the drawings can be arranged, substituted, combined, separated and designed in a wide variety of different configurations, all of which are contemplated in this disclosure.

Referring firstly to Figures 1 to 8, a first embodiment of a spacer 100 is illustrated. The illustrated spacer 100 can position a roof sheet R in a spaced relationship relative to framework (e.g. a purlin P) that is positioned below the roof sheet. However, it should be understood that the spacer 100 can be employed in a variety of other sheet-spacing applications including, for example, the spacing of sheets that are affixed with respect to internal and external walls, etc.

The illustrated spacer 100 is shown in use with framework, typically in the form of purlins P and optionally safety mesh M. The illustrated spacer 100 is employed for spacing roof sheets away from the framework. This allows insulation, such as insulation blankets, to be positioned over the purlins/mesh (i.e. see Figures 6C, 10D & E) and in an uncompressed manner under the sheets. In other words, the spacer 100 provides sufficient space to enable the insulation blankets to retain their expanded state in a roof (i.e. to retain their insulation (R') rating). However, as above, the spacer 100 can alternatively or additionally be employed to provide a cavity within a roof, wall, etc. (i.e. between the sheets and framework). This cavity may be employed to accommodate services such as electrical, cabling, wiring, water, gas, etc. Hereafter, the spacer will primarily be described in relation to the spacing of roof sheets away from roofing framework.

The spacer 100 takes the form of an elongate member 110 that extends between two opposed ends. A first of the opposed ends takes the form of a female end 130, and a second of the opposed ends takes the form of a male end 120. The male end 120 defines a type of tongue 140 at that end. The spacer 100 has a simple and easy-to-manufacture configuration in that it comprises only one leg 160 that is located at the female end 130. In the embodiments depicted in the drawings, the leg 160 is connected to the elongate member 110 (e.g. it can be integrally formed therewith). The leg 160 is arranged for positioning the female end 130 in a spaced relationship relative to framework in use.

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The leg 160, together with the elongate member 110, defines an opening 150 at the female end 130. As described in greater detail below (i.e. see Figures 7 & 8), the tongue 140 of an adjacent, like spacer 100A can be received and located in the opening 150 of an installed spacer 100. This can enable easy end-to-end alignment of adjacent spacers across a framework.

As also described in greater detail below, the spacer 100 is configured such that, instead of locating the tongue 140 of an adjacent spacer in the opening 150 of an installed spacer 100, the adjacent spacer can overlap the installed spacer (i.e. such that the tongue of the adjacent spacer locates over the installed spacer intermediate its female and male ends). This can be particularly useful at the end of a "run" of end-to-end spacers at a framework, where the final region to be spaced is shorter than the spacer length. Such overlapping can also facilitate spacer stacking as described hereafter.

Whether the tongue of the adjacent spacer is located in the opening 150 or is overlapped, the leg 160 is in each case able to support the male end 120 of the like spacer 100A in the spaced relationship with respect to the framework. Thus, the one leg 160 is able to support adjacent ends 130 and 120 of each of the adjacent spacers 100, 100A in the spaced relationship relative to the framework, resulting in insulation being less compressed in use and/or providing a cavity between the sheet(s) and framework.

The realisation that a spacer with just one leg can simultaneously support two adjacent spacers is both surprising and unexpected. Prior art spacers have at least two spaced-apart legs (i.e. to support and space opposite ends from a framework). However, because the one-legged spacer embodiments as disclosed herein can work cooperatively with a like, adjacent spacer, one leg has been discovered to be sufficient. In other words, the leg 160 of a given spacer 100 can support the male end 120 of an adjacent spacer 100A, and so on along a framework. Further, because the leg 160 is located at just one end, it can allow for the overlapping as well as stacking of adjacent spacers.

Further, by enabling the tongue 140 of the like spacer 100A to be received in the opening 150 or to overlap the spacer 100 somewhere along its length, this can allow for spacer installation at a framework in a relatively quick, safe, reliable and easy manner. The spacer configuration, including the configuration of the opening 150, can facilitate rapid spacer-to-spacer alignment. The opening 150 can also allow for multiple like spacers to be progressively installed in series across the framework, and for sheets to thus be sequentially installed. A roof sheet installer can stand on installed sheets to be safely supported as a next spacer is placed in the opening of an installed spacer. As described below, the installer can simply drop the next spacer into place on the framework, and then secure it to the framework using fasteners.

As also described in greater detail hereafter, the spacer 100 is also configured such that a lesser number of separate fasteners are required for spacer and roof sheet installation.

Referring now to Figures 3 and 4 in particular, the elongate member 110 is formed to comprise an elongate web 112 that extends along the length of elongate member 110. First and second opposing elongate walls 114 and 116 each extend from a respective elongate side of the web 112. In use, the web 112 and first and second elongate walls 114 and 116 give the elongate member 110 the form of an inverted channel section, contributing to its structural integrity, and enabling overlapping and stacking of adjacent spacers. Typically, the walls 114, 116 outwardly diverge from one another, producing a spacer that has a trapezoidal cross-section. Again, this divergence can enable overlapping and stacking and can contribute to (i.e. it can enhance) the shape of the opening 150 so as to more easily receive and to better guide therein the tongue of the like spacer 100A in use.

The elongate member 110 also includes elongate flange portions 117 and 119 that respectively project laterally outwards from the opposing walls 114 and 116. The flange portions 117 and 119 can provide further structural integrity to the spacer, and can also function as the attachment point of a respective leg 160 to the female end 130 of the elongate member 110. Also, as shown in Figure 10D, the flange portions 117 and 119 can in use rest on an underlying insulation layer I that is positioned at the framework to provide an air gap between this layer and the elongate web 112 (i.e. a gap into which fasteners can pass when introduced through the web).

Referring particularly to Figure 6, it will be seen that the leg 160 extends from each of the first and second walls 114 and 116 to define the opening 150 as locating adjacent to an end edge 112A of the web 112 and adjacent to sloping edge portions 154 and 156 of

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walls 114 and 116. More particularly, the leg 160 is formed integrally with the flange portions 117 and 119. The leg can thus be seen as a continuation of the elongate member 110, but cut at web edge 112A and edge portions 154 and 156, and yet remaining connected via the flange portions 117 and 119, and then bent into the "vertical" orientation as shown in Figure 6. This configuration helps to simplify manufacture of the spacer 100.

More specifically, leg 160 comprises an upstanding wall 164 (i.e. a "leg web") that is flanked by opposed side walls 166 and 168. Each of the opposed side walls 166 and 168 comprises a respective flange portion 167, 169. The leg flange portions 167, 169 are left intact (i.e. not cut) so as to form integrally with the flange portions 117 and 119 of the walls 114 and 116. In this way, the leg 160 is integrally connected to the female end 130 of the spacer 100.

Figures 6, 7 & 8 illustrate that the resultant leg 160 also comprises an edge 161 located at an upper distal end of the leg upstanding wall 164. This edge 161 on a first spacer 100 is in use able to support the tongue 140 of the second spacer 100A – i.e. when the latter is interconnected with the first spacer 100 (Figs. 7 & 8) or when the latter overlaps the first spacer 100.

In the spacer embodiment of Figures 1-8, the web 112 also includes one or more formations in the form of pilot holes 115 that are arranged along the length of the web 110. Each pilot hole 115 is adapted for receiving a self-tapping fastener therethrough to enable the spacer 100 to be fastened to an adjacent framework (e.g. to a purlin or stud, etc.) during use. These holes can also be used to secure a roof clip assembly A to the spacer. These roof clip assemblies A are illustrated in more detail in Figures 9, 10, 20-22.

Figures 7 to 10E show how the tongue 140 and the opening 150 allow two spacers 100 and 100A to be inter-connected during use. Specifically, the tongue 140 of the second spacer 100A is received and secured within the opening 150 of a first, installed spacer 100 in a kind of push-fit, thereby inter-connecting the first and second spacers 100 and 100A end-to-end. For example, a roof sheet installer is able to stand on an installed roof sheet R that is supported by multiple parallel installed spacers 100. The installer is safely supported on roof sheet R and, from a standing position, is then able to insert the tongue 140 of a next spacer 100A in the opening 150 of each installed spacer 100. The installer may position the tongue 140 of spacer 100A into the opening 150 of spacer 100 without needing to bend down.

Having inserted the tongue, the installer can simply drop spacer 100A, and it then pivots around its male end 120 located at the leg 160 and into place on the framework – i.e. with the leg 160 of the next spacer 100A locating at the framework. The spacer 100A can then be secured to the framework (e.g. purlin, stud, etc.) by one or more fasteners.

Turning now to Figure 5, an enlarged view of the tongue 140 at the male end 120 is illustrated. It will be seen that each of the first and second walls 114 and 116 are each cut at 141 so as to be truncated adjacent to the respective flanges 117, 119. The truncated walls extend to respective distal edges of the walls 114, 116 that are aligned with a distal end 143 of the web 112. This truncation provides the tongue-like shape of the male end 120 that facilitates its receipt and guidance into the opening 150 of an adjacent spacer in use. During receipt of the tongue 140 in the opening 150, a suitable interference fit is able to be achieved.

To assist with such receipt, guidance and interference fitting, the distal end 143 of the web 112, and optionally also adjacent to the truncated 141 elongate walls, can be provided with one or more notches that are formed thereinto. In the embodiment of Figure 5, two corner notches 149A and 149B are provided. In the embodiment of Figures 11-15, a single, central notch 149 is provided. Figures 15A and 15B also illustrate variations in the length of each single, central notch 149. In the embodiment of Figures 16 & 17, a central notch 149 together with edge notches 149A and 149B are provided. The notch(es) 149 help to facilitate insertion of the tongue 140 in the opening 150 (i.e. by enabling the tongue to deform inwardly).

Returning again to Figure 6, it will be seen that the opening 150 is in part defined by the edge 112A of the web 112 and by the sloping edge portions 154 and 156 of the walls 114 and 116 respectively. The taper 141 of the tongue 140 can engage with and be

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guided down the sloping edge portions 154 and 156 during insertion of the tongue 140 into the opening 150, to provide a guide mechanism for tongue insertion.

Likewise, it will also be seen that the opening 150 is in part defined by the upper edge portion 161 of the wall 164 of leg 160. Additionally, respective upper portions of each of the leg side walls 166 and 168 include sloping edges 163 and 165 which also define the opening and which slope downwardly from edge portion 161 to the joint of flanges 117, 167 and 119, 169. As best shown in Figure 7, the upper edge portion 161 and sloping edges 163 and 165 also provide a guide mechanism for directing the diagonally oriented tongue 140 of the second spacer 100A into the opening 150 of the first spacer 100.

These respective guiding mechanisms around the opening 150 allow a roof installer to safely, easily, reliably and speedily position the tongue 140 of spacer 100A into the opening 150 of spacer 100A in a diagonal orientation (i.e. from a standing position). They also help to facilitate pivoting in an arc of the male end 120 of spacer 100A about the leg 160 and female end 130 of spacer 100 when released by the roof installer.

Once the second spacer 100A has been installed, it will be seen in Figure 8 that the flange portions 117, 119 at the male end 120 of spacer 100A abut at 118 the flange portions 117, 119 at the female end 130 of the spacer 100. Thus, a snug, generally flush joint results.

Referring now to Figures 23, 23A and 24, 24A, the join that is defined between the elongate member flanges 117, 119 and the leg flanges 167, 169 can each comprise a respective gusset G formed therein (e.g. that is press-formed therein prior to or during leg bending). These gussets G can stiffen and strengthen the leg-to-elongate member joint, helping the leg to resist deflection and to support a load, including an installer's weight thereon during use.

Referring now to Figures 25 and 25A, the joins that are defined between the elongate web 112 and the opposing elongate walls 114 and 116 can comprise a number of spacer formations D defined therein (e.g. that are press-formed therein prior to or during bending of the walls). The spacer formations D can alternatively be formed just in the web 112, or just in the walls 114 and 116. The spacer formations D can aid in storage

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and transport of the spacers prior to use, acting to prevent stacked spacers from nesting too tightly (e.g. which may result in adjacent spacers fastening to each other), and making it easier to unpack the spacers for use. Further, the spacer formations D can improve air flow between stacked spacers in storage, aiding drying in the event of water ingress and helping to prevent corrosion.

The installation procedure, including spacer fastening to the framework, will now be described with particular reference to Figures 6A to 6C, 9 and 10. The method of inter-connecting adjacent spacers can be repeated across a framework (e.g. along the line of each of the purlins or studs thereof, etc.).

In an initial step, an insulating layer I is positioned above the framework (Fig. 6C), which may be in the form of a series of parallel purlins P that have a safety (fall) mesh M extending across the space therebetween. The insulating layer I is typically in the form of a roll of insulating (e.g. glasswool) material that is rolled out over the framework P. The safety mesh M also helps to hold the insulating layer I positioned over the space between the framework P and the roof sheets R.

Referring now to Figures 6A and 6B, a spacer male end support, in the form of a starter saddle 200, is located over the insulating layer I adjacent to a starting end of the framework (e.g. above each of the parallel purlins or studs at one side of the roof, wall, etc.). The saddle 200 takes the place of a leg for a first-to-be-positioned spacer at its male end 120.

As specifically illustrated in Fig. 6B, the starter saddle 200 comprises a base web 202 which sits on the insulating layer I and which can then be screwed down into an underlying purlin P, such as through one or more (e.g. up to three) screw holes 203 formed through the base web 202, depending on the installation method used. A central such hole 203 can be employed where the saddle 200 is screw-secured from the top, whereas the side such holes 203 can be employed where the saddle 200 has been pre-attached to the spacer 100, and an installer is then screw-securing from the side.

The starter saddle 200 also comprises opposing walls 204, 206 which extend up from the base web 202. Each wall has a rebate 208 defined along its upper edge, with the rebate sized to receive therein the flange portions 117 and 119 of the overlying spacer

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100. The opposing side walls 210, 212 of the rebate 208 are also half-diamond shaped to project inwardly of the rebate. Thus, the flange portions 117 and 119 of the overlying spacer 100 must be slid in under the side walls 210, 212, or press-fit down into the rebate in use. This helps to secure the starter saddle 200 adjacent to a spacer male end 120.

The starter saddle 200 further comprises gussets 213 formed at the joints between the base web 202 and the opposing walls 204, 206. These gussets 213 stiffen and strengthen the base web-to-opposing wall joins, helping the saddle 200 to resist deflection and to support a load, including the roofing installer's weight during use.

Each starter saddle 200 thus maintains a spaced relationship of the spacer male end 120 above the framework. With the starter saddle 200 e.g. screwed into place, the first spacer 100 may now be positioned and then fastened into place, and then subsequent spacers 100A, 100B, 100C, etc. may then be positioned and fastened into place, end-to-end along the framework. This provides for the required spacing between the roof sheets and the framework for receipt of the insulation layer I therein.

Turning now to Figures 26 and 26A, it will be seen that the elongate flanges 117, 119 of a further spacer embodiment 100^{VI} can be provided with a number of discrete support formations in the form of location dimple pairs 300. These pairs are located proximal the spacer male end 120. The dimple pairs 300 can be press-formed therein prior to or during bending of the flanges, and protrude from the underside of the flanges 117, 119. The dimple pairs 300 function to locate with respect to, and to thereby interfere with, the opposing rebates 208 of the starter saddle 200 (Figure 6A). Thus they locate and also help resist the spacer male end 120 from sliding-out of the rebates 208. This interference further contributes to securement of the spacer 100^{VI} in the starter saddle 200.

As illustrated by Figure 9, and Figures 10A to 10C, a first spacer 100 may be secured to the framework (purlin P) by one, two or three fasteners F. The fasteners F may each take the form of an elongate self-tapping roof screw. The length of each fastener F is optimised to a given spacer. Typically, the first spacer 100 is secured by the fasteners F to a purlin P before arranging the second spacer 100A, etc. Figures 9 and 10A show a three-screw option, whereas Figure 10B shows a two-screw option, and Figure 10C shows a one-screw option.

Where a roof clip bearing assembly is to be employed, roof clips C and/or a roof clip-bearing assembly A are typically fastened to each roof spacer prior to positioning each roof sheet above the framework P. Whilst single clips may be secured to a spacer, each by a respective fastener, typically a roof clip-bearing assembly A having a plurality of clips already secured thereto is employed. The roof clips C and/or a roof clip-bearing assembly A can be used for push-fitting roof sheets R onto the spacers 100 as best shown in Figures 9 & 10D to E. They provide for a “concealed” means of fastening of roof sheets.

To enable a roof clip-bearing assembly A to be appropriately aligned at each spacer, and as best shown in Figures 11, 12, 15, 18 to 22 and 24, the web 112 is pre-configured to receive the roof clip-bearing assembly A thereat. Specifically, the elongate web is provided with two spaced, elongate apertures 111A and 111B (see also Fig. 13). The spacing of these apertures is made to suit the type of clip-assembly A that is to be secured to the spacer 100 (see e.g. the different clip-assembly types in Figure 22).

Further, and as best shown in Figures 18-21, at the end of elongate aperture 111A (i.e. adjacent to the female end 130), the web 112 is also provided with a stop member, in the form of a tab 113. The tab 113 is in the form of an upwardly directed projection that is sized and located such that a distal edge D^e of the roof clip-bearing assembly A is able to abut therewith (Figure 21), and thereby be properly aligned on the roof spacer. Preformed apertures H in the assembly A then align with the elongate apertures 111A and 111B in the web 112, and optionally can also align with the holes 115 in the web 112.

Once the roof clip-bearing assembly A has been suitably aligned on the web 112, the one, two or three self-tapping fasteners F can be screwed therethrough. Some of those fasteners F’ may only screw through the assembly A and web 112 (i.e. they do not have sufficient length to then screw through to the purlin P). However, typically the fasteners F have a length and configuration so as to not only screw through the assembly A and web 112, but to then screw through and into the framework (e.g. into purlin P). Such

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fasteners F thereby simultaneously fasten the roof clip-bearing assembly A and the spacer 100 to the framework. This reduces the number of fasteners required and speeds up installation time.

Once the first series of spacers 100 and associated assemblies A have been secured to the framework P, a first roof sheet R can now be push-fit onto the clips C of the assemblies A, as shown in Figure 10D & E. A next spacer 100A can now be secured to each of the installed spacers 100, and the procedure of securing the spacers 100A and associated assemblies A to the framework (e.g. to purlin P) can be repeated, and so on across the full span of the framework.

The roof clip assembly A can be manufactured in a variety of mounting arrangements as shown in Figure 22 (i.e. arrangements A through to G), each of which is configured to suit a particular roof sheet of a particular manufacturer. Each such roof clip assembly A-G is suitable for fastening a particular manufacturer's roof sheets in a concealed manner (i.e. without a fastener penetrating the roof sheets). The rail of each such clip assembly A-G may have slightly different lengths. The elongate apertures 111A and 111B in web 112 are such as to accommodate the different roof clip assemblies A of different manufacturers, and to accommodate the different lengths. Thus, the fasteners F can be located and received anywhere along the length of the elongate apertures 111A and 111B.

Referring now to the embodiment of the spacer shown in Figure 23, a spacer 100^{IV} has formations in the web 112 that take the form of a plurality of deformations 170 spaced out along the web. Each such deformation may be concave towards a central hole or a thinned web region 172. The spacings of the deformations 170 typically correspond to the spacings of suitable formations of an overlying roofing sheet (e.g. to the ridge-to-ridge spacing of roof sheet corrugations). The deformations 170 provide a pilot point to allow a self-tapping fastener that is externally driven through e.g. the ridge of the roof sheet, to then centre and pierce through the web region or hole 172, and to then pass through to tap into and secure to the framework. Such fasteners are "exposed" (as opposed to being "concealed"). Alternatively, the deformations 170 may enable one or more respective roof clips or roof clip-bearing assemblies to be secured to the web.

Having now secured the first spacer 100 to the purlin P, the tongue 140 of a diagonally oriented second spacer 100A is then positioned into the opening 150 of spacer 100. During such installation, the installer initially gently pushes (i.e. to begin insertion of) the tongue 140 into the opening 150. Once fully inserted, the installer then simply releases spacer 100A, with this spacer then pivoting around the female end 130 and leg 160 of spacer 100, in alignment with and such that its leg then locates over the purlin P. There is no need for a separate alignment step for the spacer 100A. In this regard, both its insertion and pivoting is guided by the configuration of opening 150, as set forth in the guiding mechanism outlined above. This considerably simplifies and expedites spacer mounting to a roof structure.

Having been so inter-connected, the spacers 100, 100A, 100B, etc. are positioned and aligned upon the framework P, and do not move relative to each other but rather tend to remain in position. Thus, a roof installer has the option of connecting two or more of the spacers, using the above mentioned connecting methodology, before fastening each of the spacers to the underlying framework.

Where the inter-connected spacers 100, 100A, 100B, etc. have a combined length that is greater than the expanse of the framework P, a final spacer 100X can, instead of having its tongue 140 located in the opening 150 of a penultimate installed spacer, overlap the penultimate installed spacer (i.e. such that the tongue of the final spacer locates over the penultimate installed spacer intermediate its female and male ends). This can enable an even finishing of a “run” of end-to-end spacers at the framework P (e.g. such that the leg 160 of the final spacer locates on a final end member of the framework).

The number of screws or fasteners used for fastening the spacers to the framework can vary, depending on the building requirements. By way of example, not every aperture 111, 115 or deformation 170 may require a screw or fastener. The required number of screws or fasteners will depend on loads to be experienced in use, particularly in areas subject to severe weather events (for example, cyclones/hurricanes). A lesser number of screws or fasteners may be employed for roofs which are not likely to be exposed to extreme weather events.

Referring now to Figures 11 to 21, further embodiments of a spacer are illustrated. Like reference numerals denote like features which have been previously described, and hence will not be redescribed.

Turning now to Figure 15A, an enlarged view of the tongue 140’ at the male end 120 of spacer 100’ is illustrated. It will be seen that each of the first and second walls 114, 116 each taper 142’ from a point adjacent to the respective flanges 117, 119 towards a distal end 143 of the web 112. This tapering contributes to a shape of the male end 120 that facilitates its receipt and guidance into the opening 150 of an adjacent spacer in use. Figure 15B shows a similar enlarged view of the tongue 140’ at the male end 120 of spacer 100, but illustrates a variation to Figure 15A, where the degree of taper 142” is reduced in order to modify the interference fit between the tongue 140’ and the opening 150 during tongue 140’ receipt therein. In each case, the degree of taper is such that, during receipt of the tongue 140’ in the opening 150, a suitable interference fit is able to be achieved.

As set forth above, the embodiments of Figures 15A & 15B each comprise just a single, central notch 149 to facilitate insertion of the tongue 140’ in the opening 150 (i.e. enabling the tongue to deform inwardly).

Referring now to Figures 16 and 17, a third embodiment of a spacer 100” is shown. The tongue 140” still comprises a taper 142”, though of lesser degree than taper 142’ in the spacer embodiment of Figure 15A and closer to the taper of the spacer embodiment of Figure 15B. The tongue 140” also has a length L that is further modified to facilitate its receipt and nesting into the opening 150 located at the elongate member second end 130.

In the spacer 100”, in addition to the central notch 149, the tongue 140” further comprises the discrete, short edge notches 149A and 149B. The central notch 149 and edge notches 149A and 149B define in the tongue 140” two adjacent, but spaced tongue end portions 145A and 145B. The end portions 145A and 145B are movable relative to each other and allow the tongue 140” to be more easily and readily press-fitted into the opening 150 in use.

Typically, the spacer 100, 100', 100", 100^{IV}, 100^{V}, 100^{VI} is formed from sheet material, for example, it may be cut, pressed-formed and/or bent from sheet metal (e.g. a galvanised or a Zn-Al coated steel sheet, aluminium sheet, etc.). The spacer may be formed in a manufacturing method that comprises the following steps:

A. supporting the sheet material and forming discrete cuts through and deformations in the sheet. The cuts can correspond to the opening 150, the notches 149 (and optional notches 149A, 149B), and the apertures/holes 111, 115; the deformations can correspond to the optional formations 170, D, 300, etc.

B. sectioning the sheet of material (with the discrete cuts and deformations therein) to produce a blank that is ready for press-forming/bending (i.e. to form the elongate member 110 and leg 160). Note – step B. can be performed before step A.

C. where deformations 170, D, 300 and gussets G are required in the spacer, these can be press-formed therein (e.g. prior to step D such as during step A, or as part of step D).

D. bending and/or folding the section of sheet (blank), such as by a press-forming operation, to define the web 112, the first and second walls 114, 116, the flange portions 117, 119 and the corresponding walls 166, 168 and flanges 167, 169 on the leg 160.

E. bending the elongate member 110 adjacent to the discrete cut so as to form the leg 160, and such that the leg extends down and generally at a right angle to the elongate member 110.

As set forth above, whilst the spacer has been primarily described with reference to its application in roofing, the spacers can be used in walls, partitions, etc. that may require insulation that needs to be maintained in an expanded state, and/or to provide cavities for services, etc.

Variations and modifications may be made to the process previously described without departing from the spirit or ambit of the disclosure.

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In the claims which follow and in the preceding summary, except where the context requires otherwise due to express language or necessary implication, the word “comprising” and variations is used in the sense of “including”, that is, the features may be associated with further features in various embodiments.

CLAIMS

1. A spacer for positioning a sheet in a spaced relationship relative to framework that supports the sheet in use, the spacer being elongate and extending between first and second opposite ends, the spacer comprising one leg only that is located at the first end, the leg comprising a wall that defines an upper distal end, whereby the leg is arranged for positioning the first end in a spaced relationship relative to the framework and whereby the leg extends from the first end in a manner that defines an opening at the first end, such that the second end of a like spacer is able to be received in the opening to locate at and pivot on the upper distal end, and whereby the leg of the like spacer is able to position the like spacer first end in a spaced relationship relative to the framework.

2. A spacer according to claim 1, wherein the upper distal end of the leg comprises an edge that supports the second end of the like spacer during pivoting of the like spacer and when in the spaced relationship relative to the framework.

3. A spacer according to claim 1 or 2, wherein the spacer comprises an elongate web and opposing elongate walls that each extend from a respective elongate side of the web, and wherein the web comprises one or more of:

- one or more formations therein, each formation configured for enabling a fastener to pass through the web;
- one or more apertures therein, each aperture configured for enabling a roof clip-bearing assembly to be arranged at and/or secured to the web.

4. A method for forming a spacer as set forth in any one of the preceding claims, the method comprising:

- bending and/or folding a section of sheet material to define the elongate spacer as extending between the first and second opposite ends;
- cutting and bending the elongate spacer at the first end so as to form the leg such that the leg extends from the first end in a manner that defines an opening at the first end.

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5. A method for arranging a plurality of spacers, each as set forth in any one of the preceding claims, to enable positioning of one or more sheets in a spaced relationship relative to framework that supports the sheet(s) in use, the method comprising:

- arranging a first spacer relative to the framework, such that the leg of the first spacer locates at the framework and maintains a spaced relationship of the first spacer first end relative thereto;
- arranging a second spacer such that the second end of the second spacer is located in the opening at the first end of the first spacer;
- pivoting the second spacer around its second end until the leg of the second spacer locates at the framework to support the first end of the second spacer in the spaced relationship relative to the framework.

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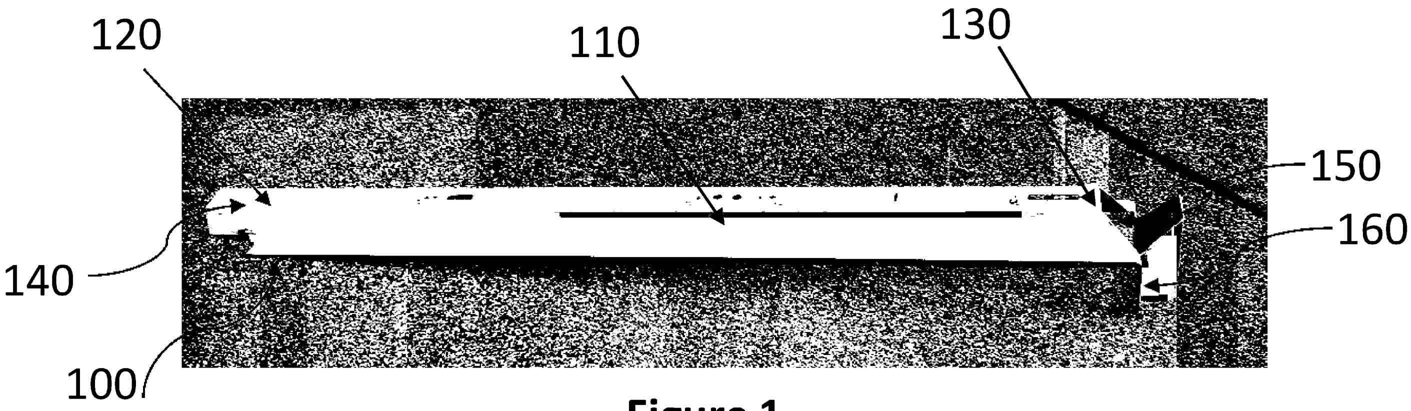

Figure 1

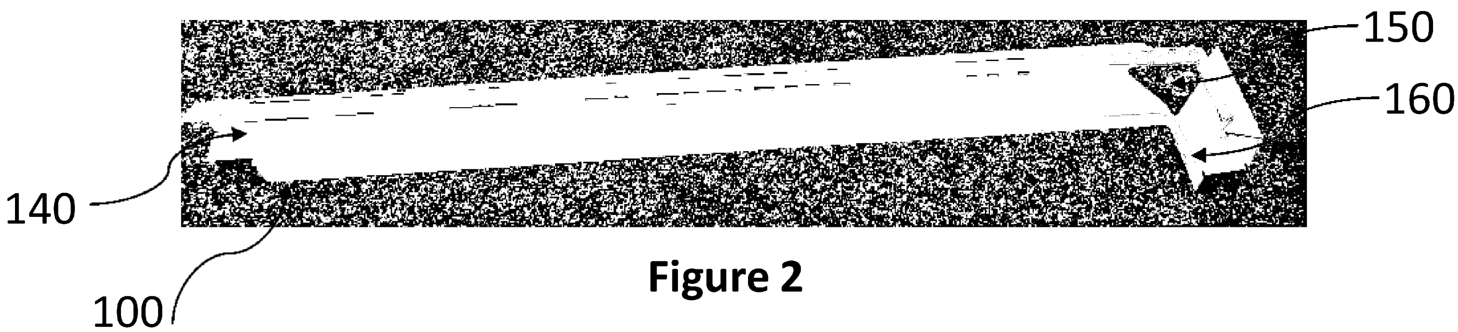

Figure 2

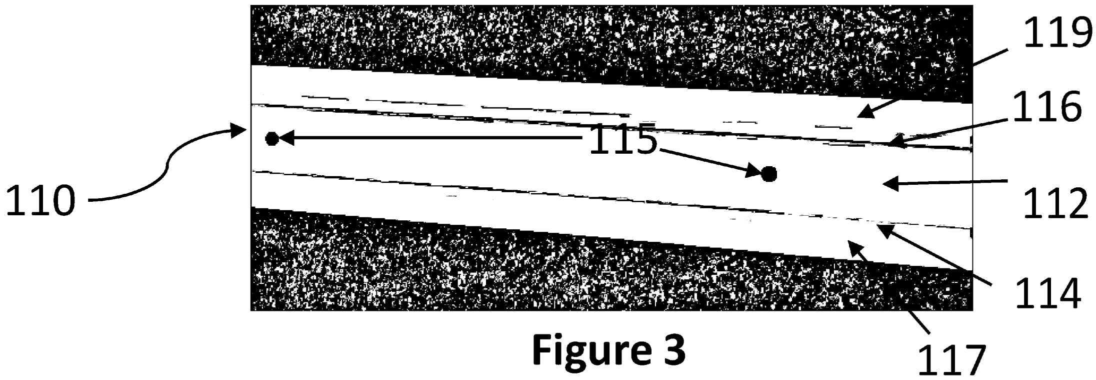

Figure 3

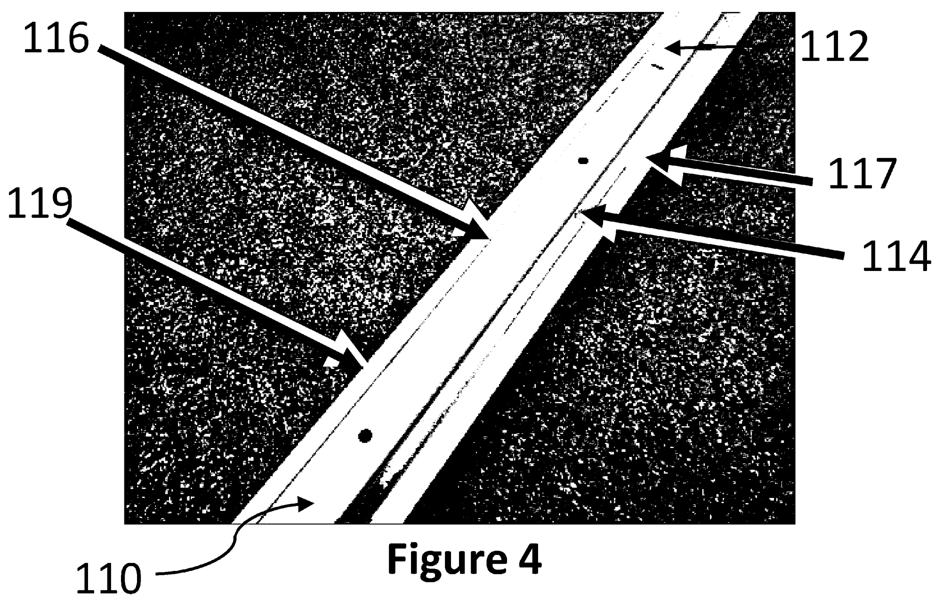

Figure 4

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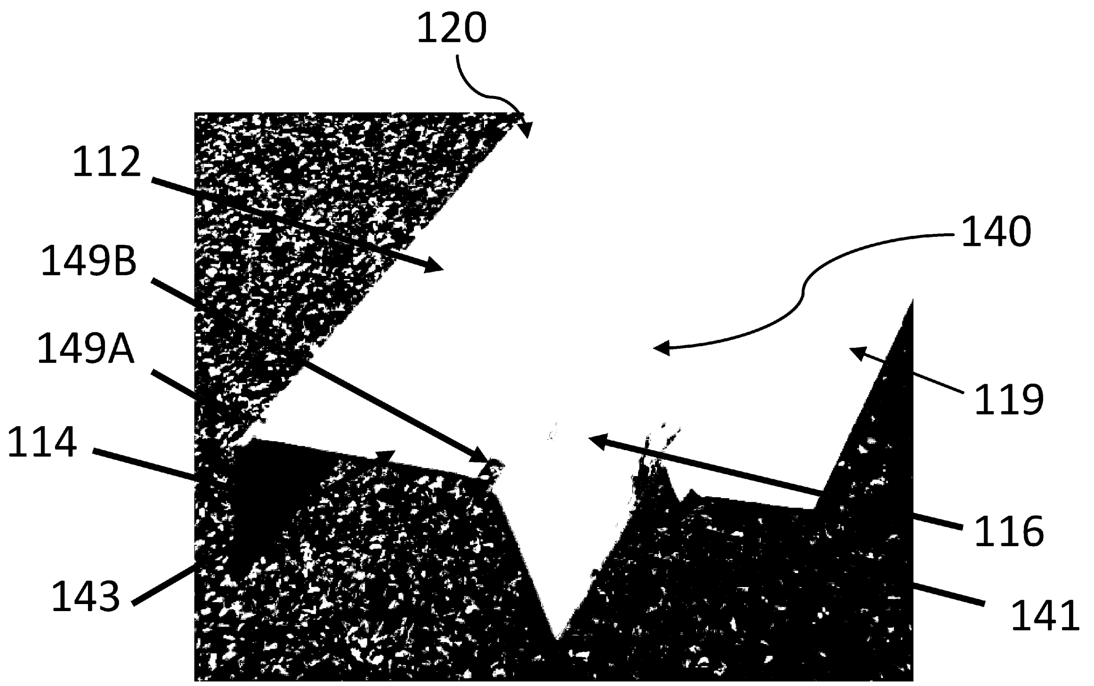

Figure 5

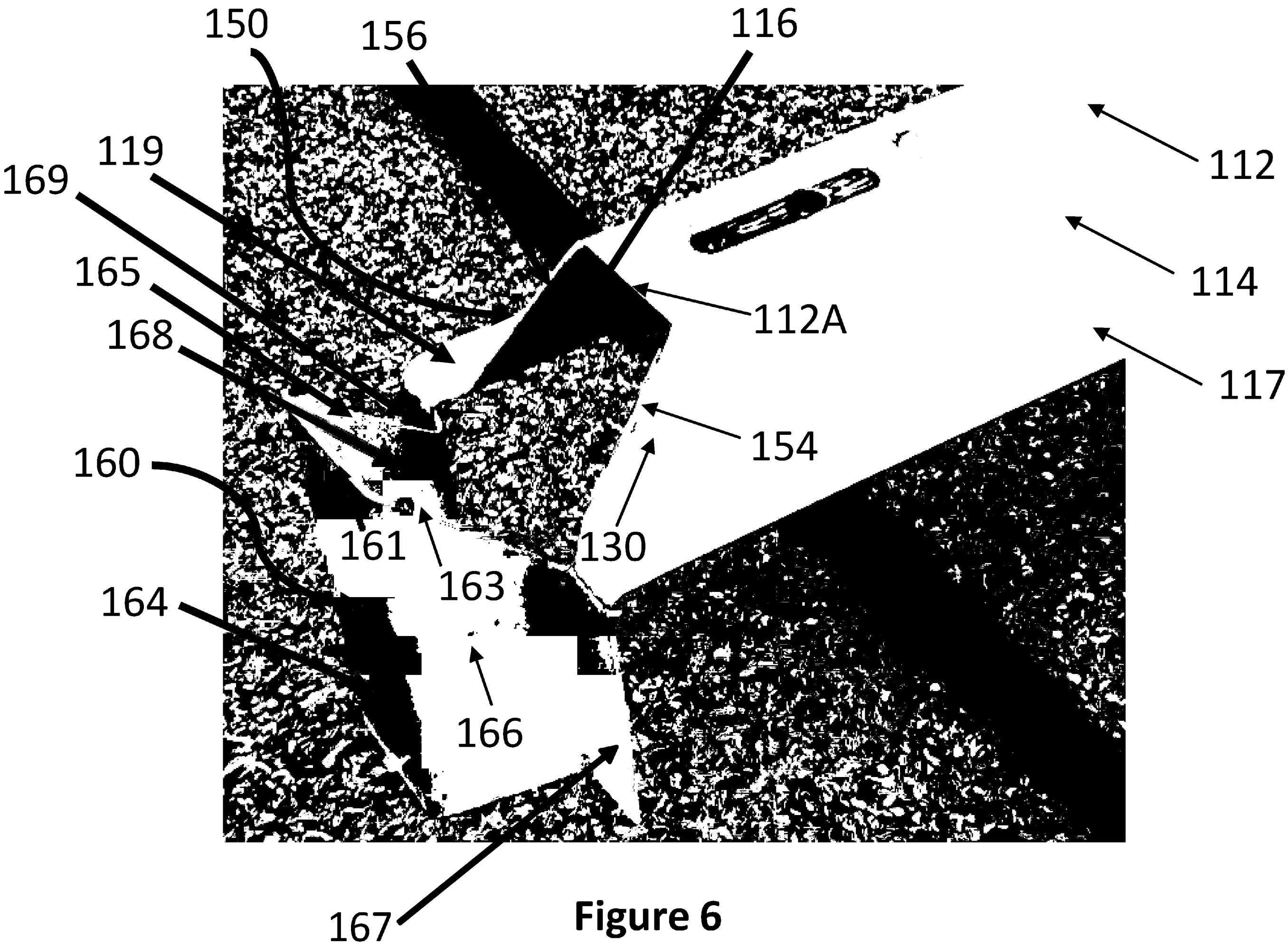

Figure 6

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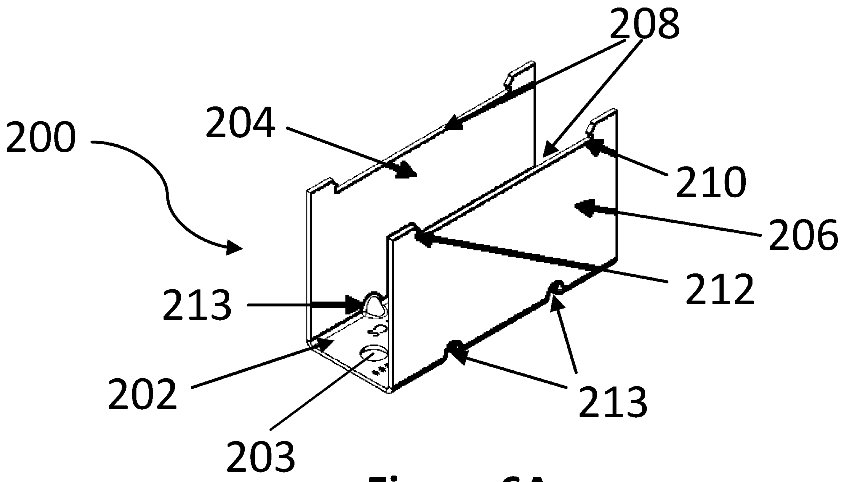

Figure 6A

Figure 6B

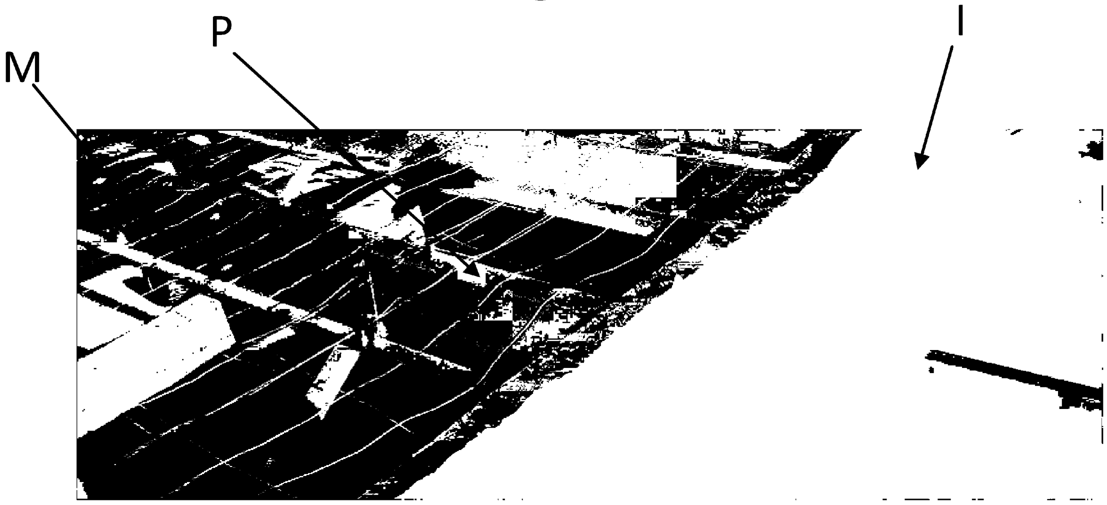

Figure 6C

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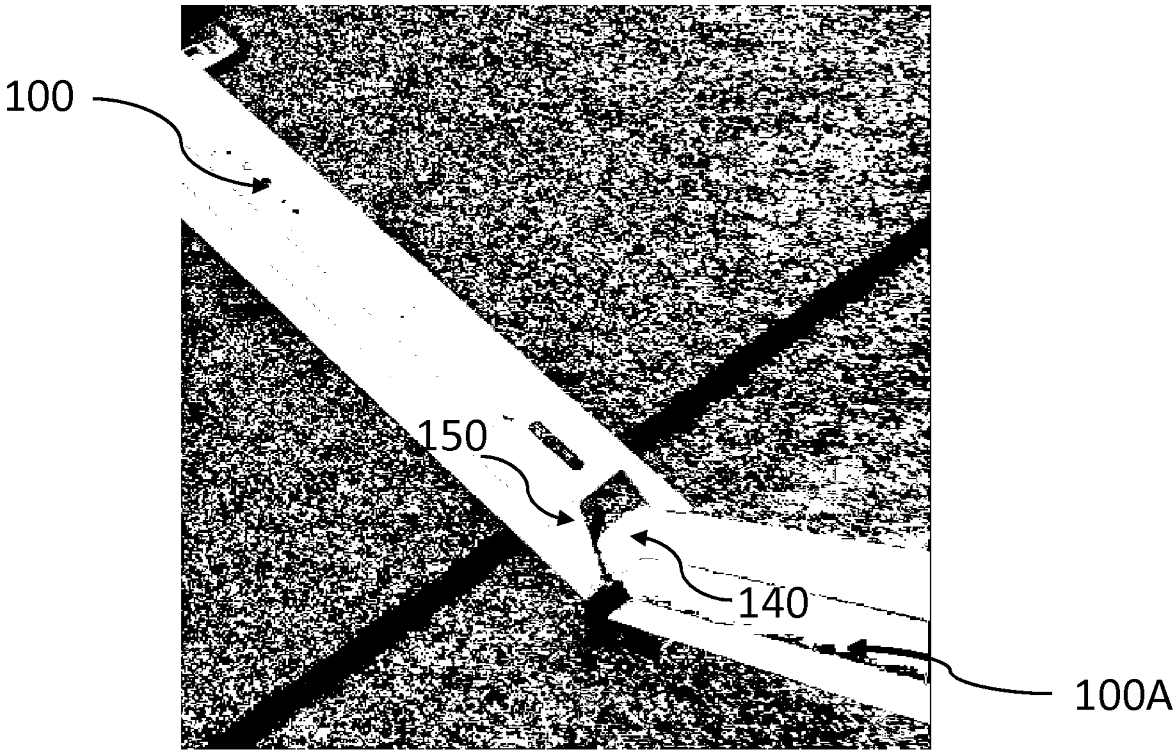

Figure 7

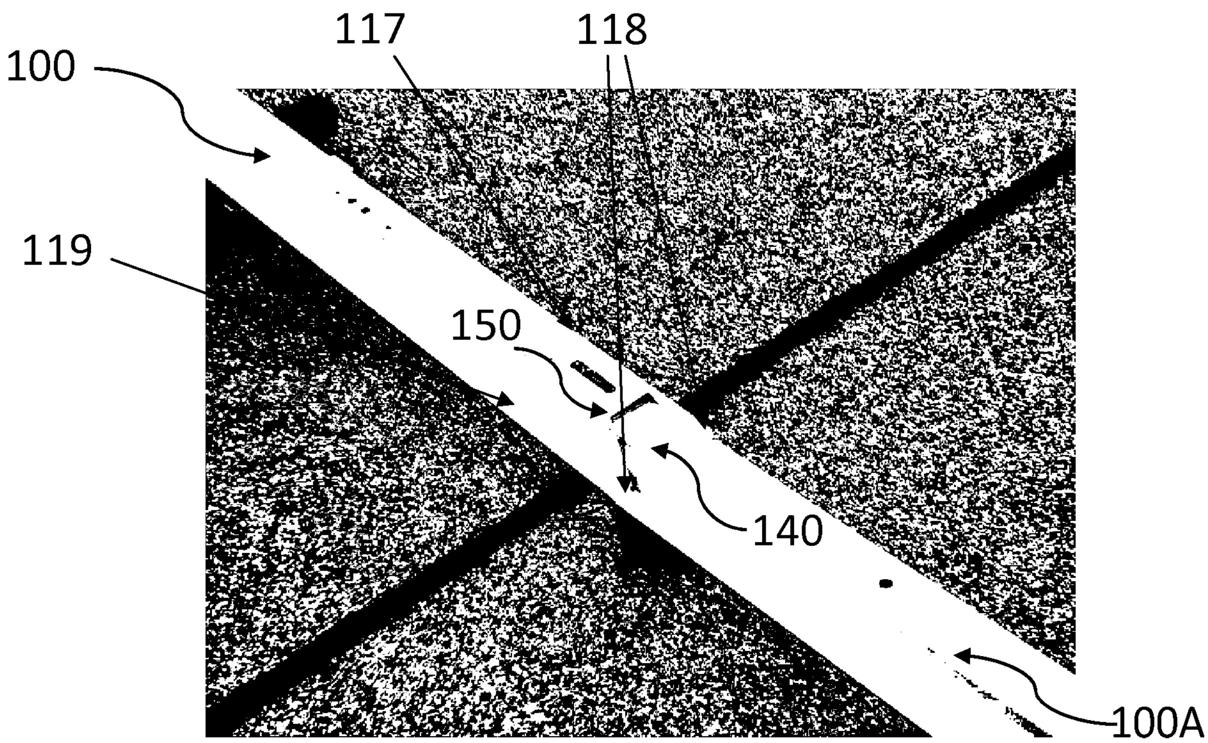

Figure 8

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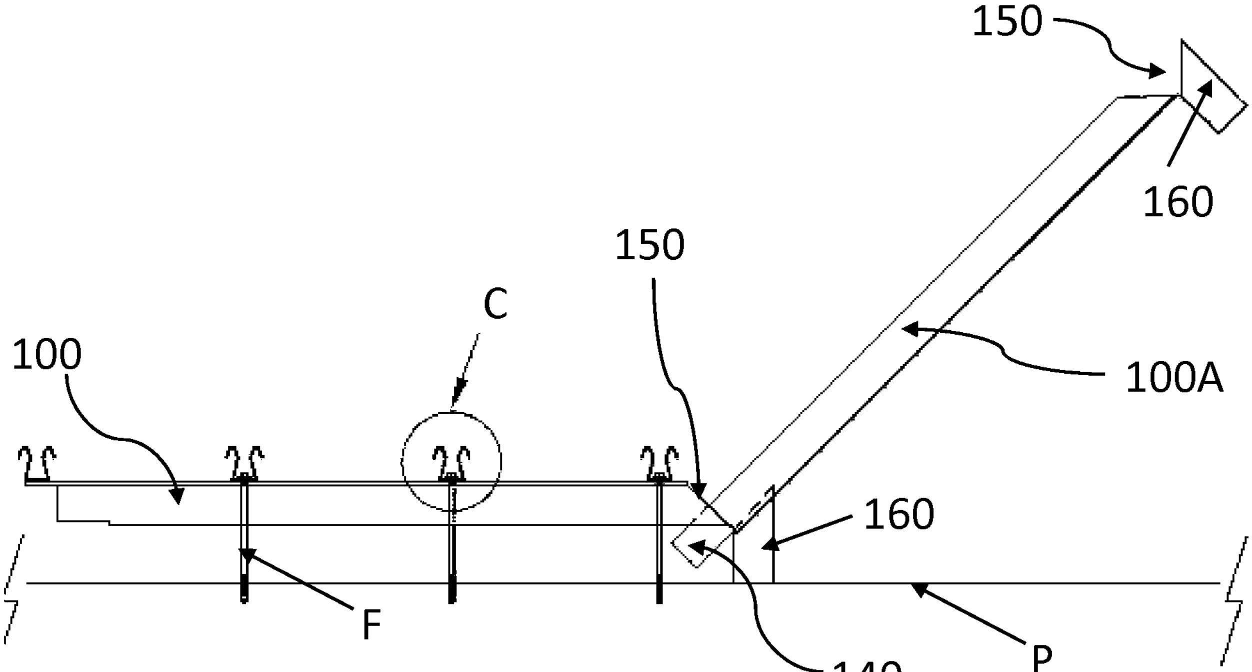

Figure 9

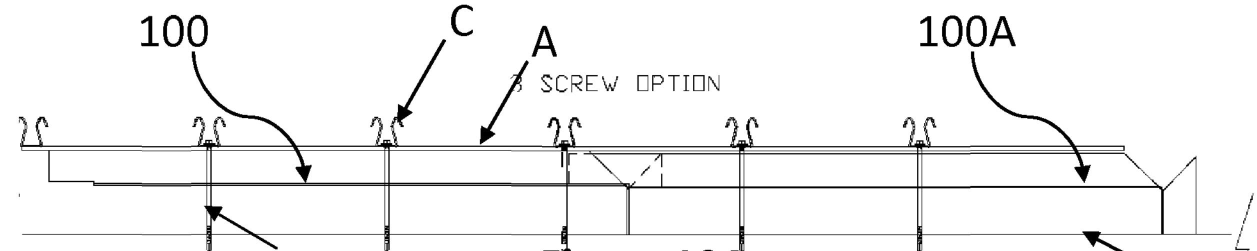

Figure 10A

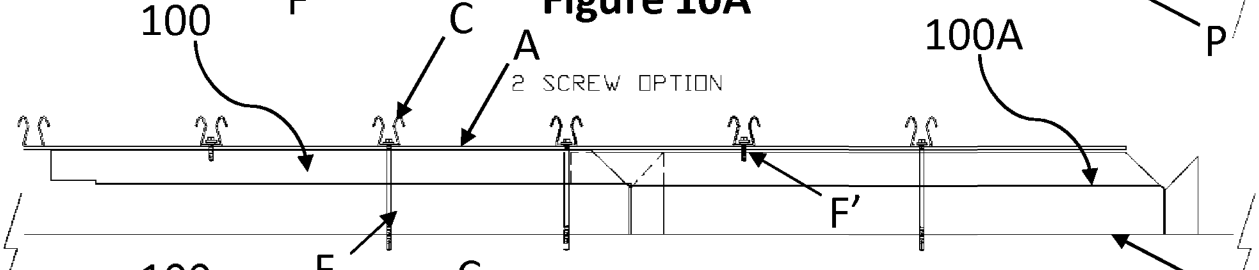

Figure 10B

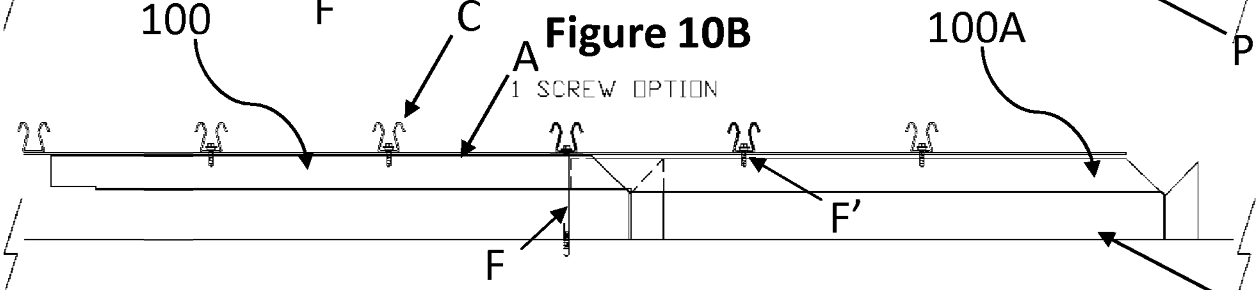

Figure 10C

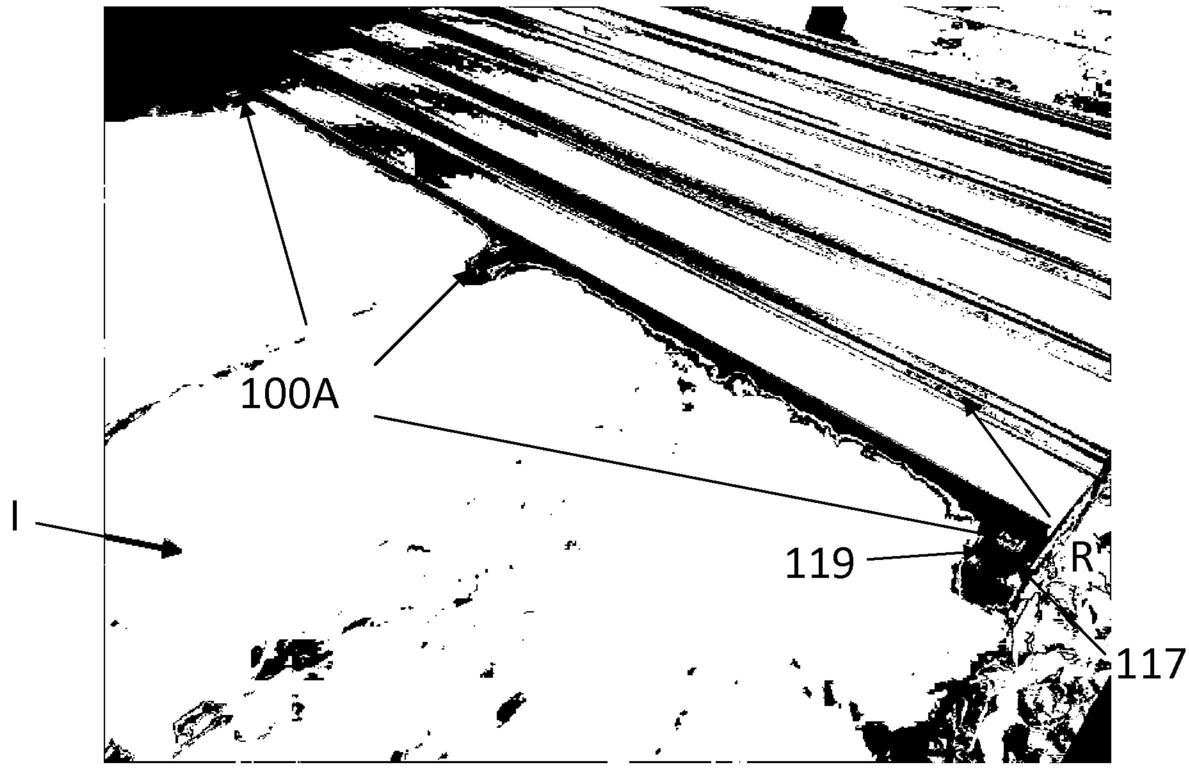

Figure 10D

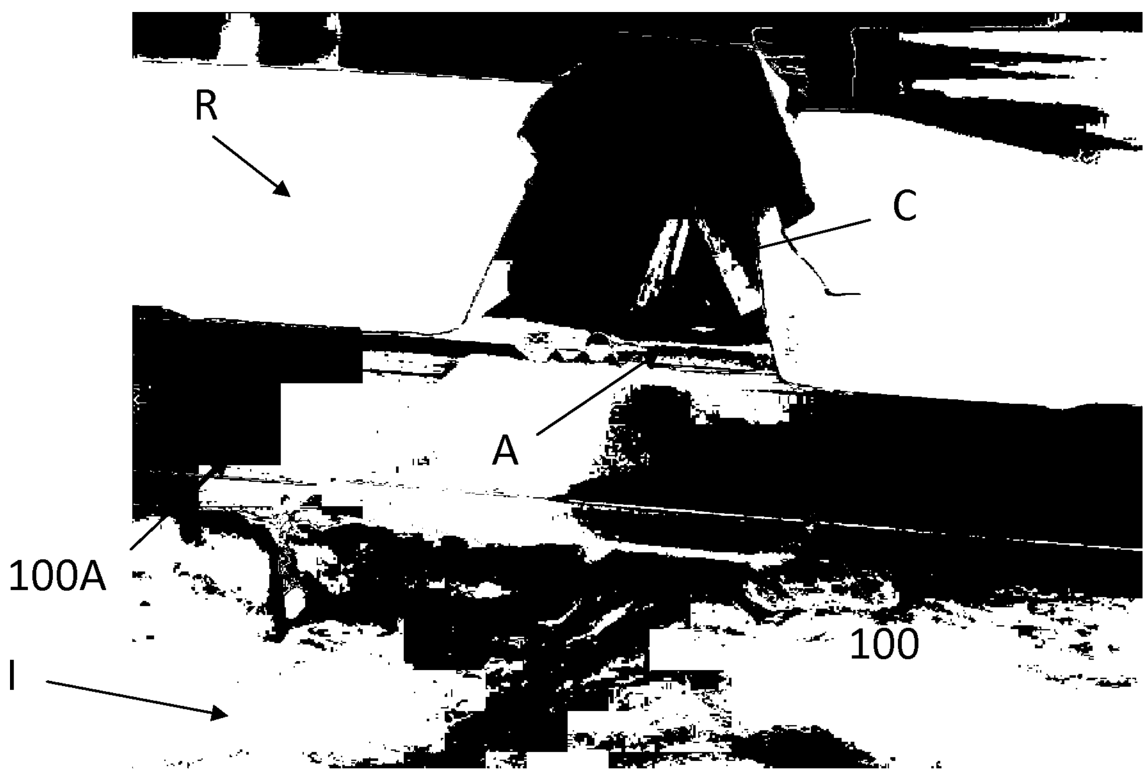

Figure 10E

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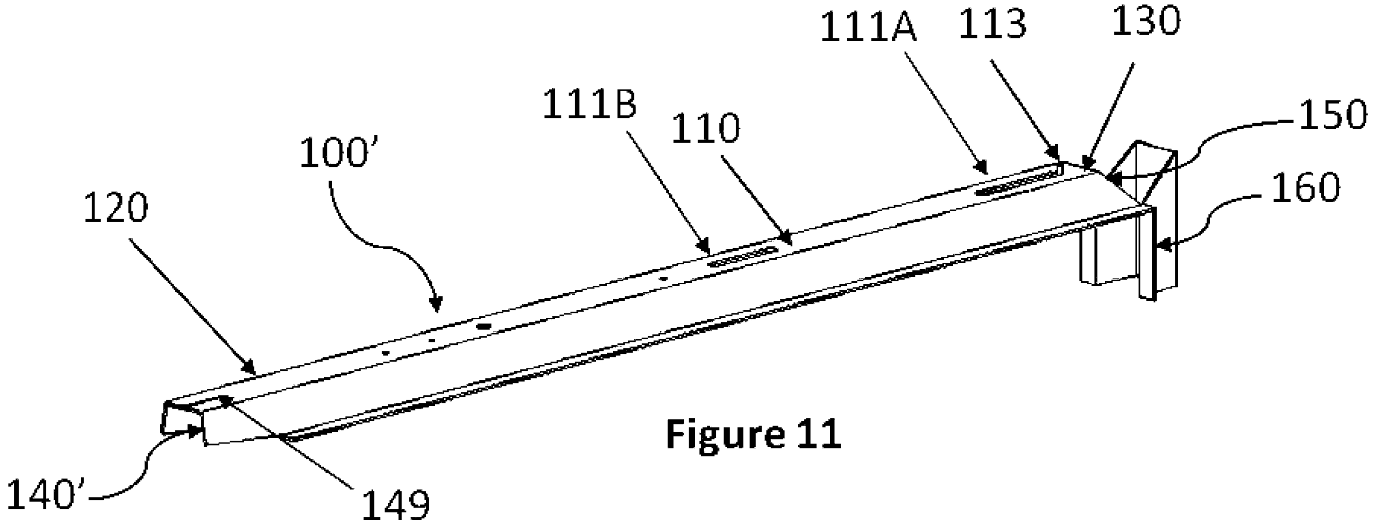

Figure 11

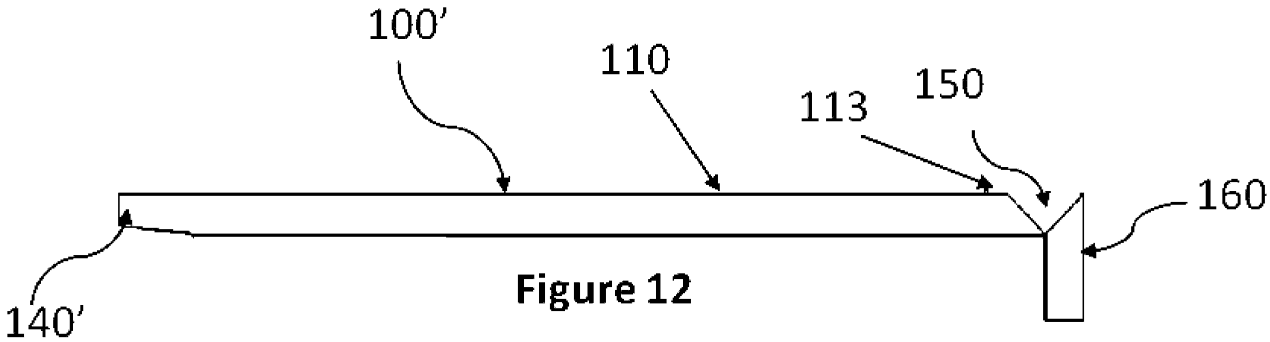

Figure 12

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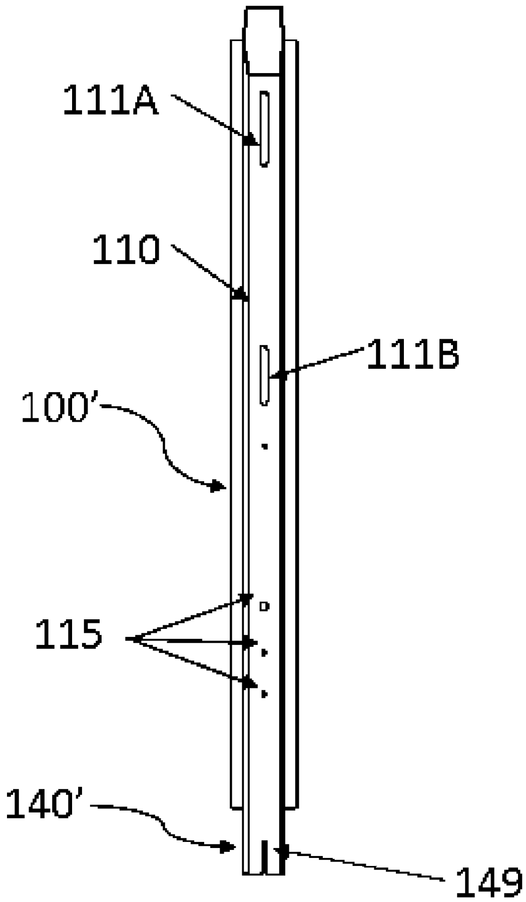

Figure 13

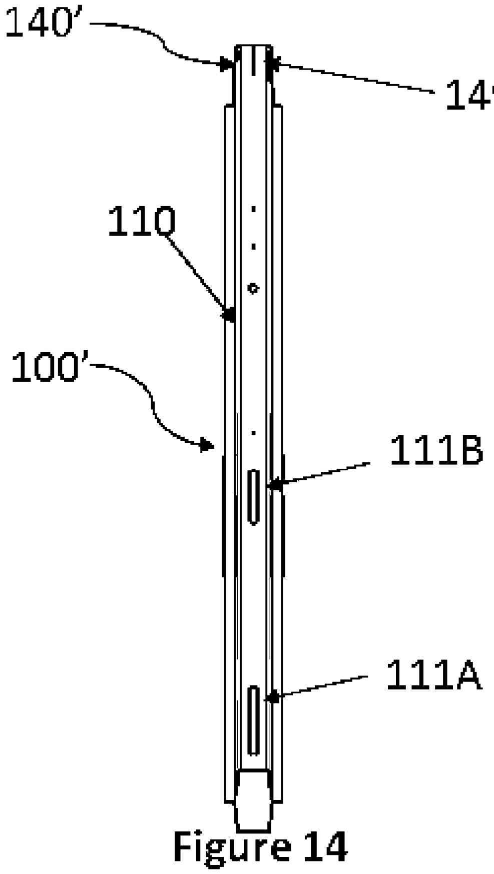

Figure 14

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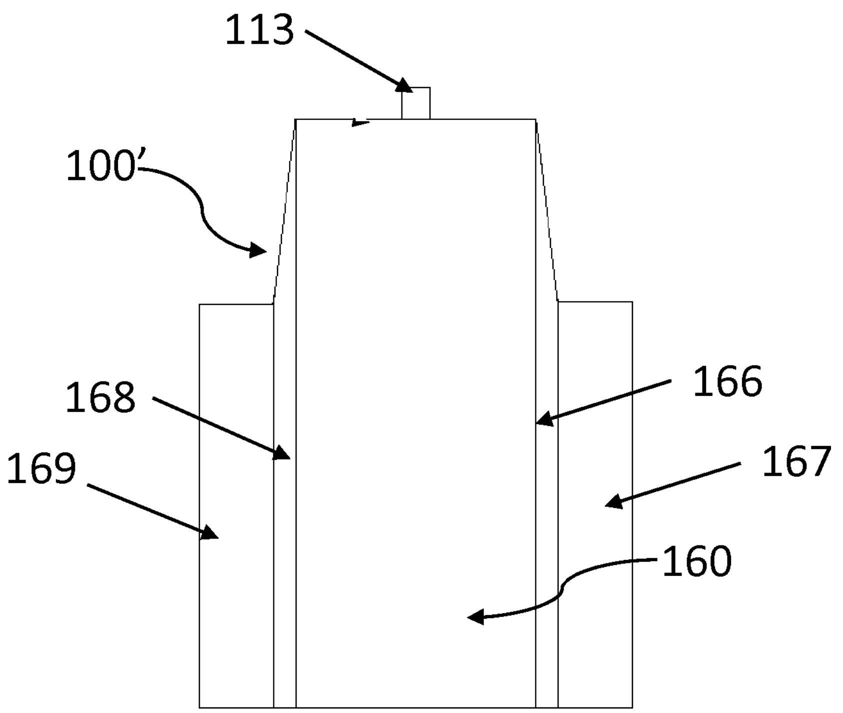

Figure 15

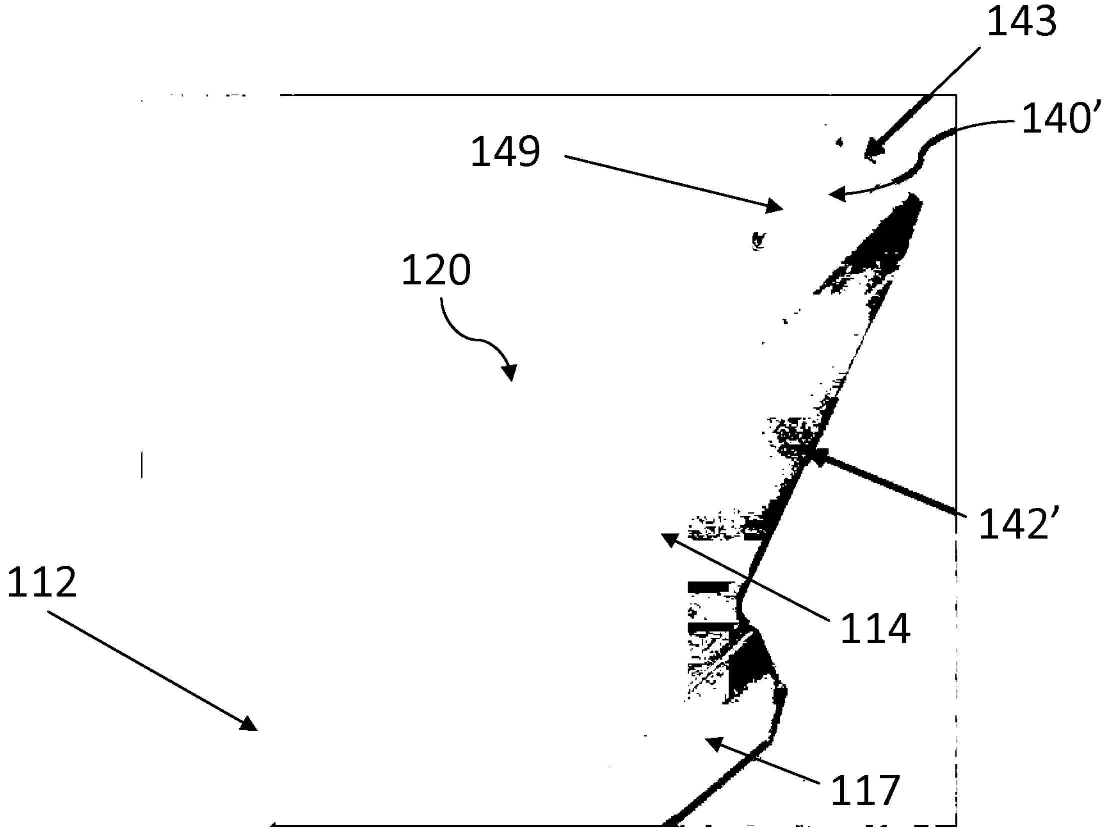

Figure 15A

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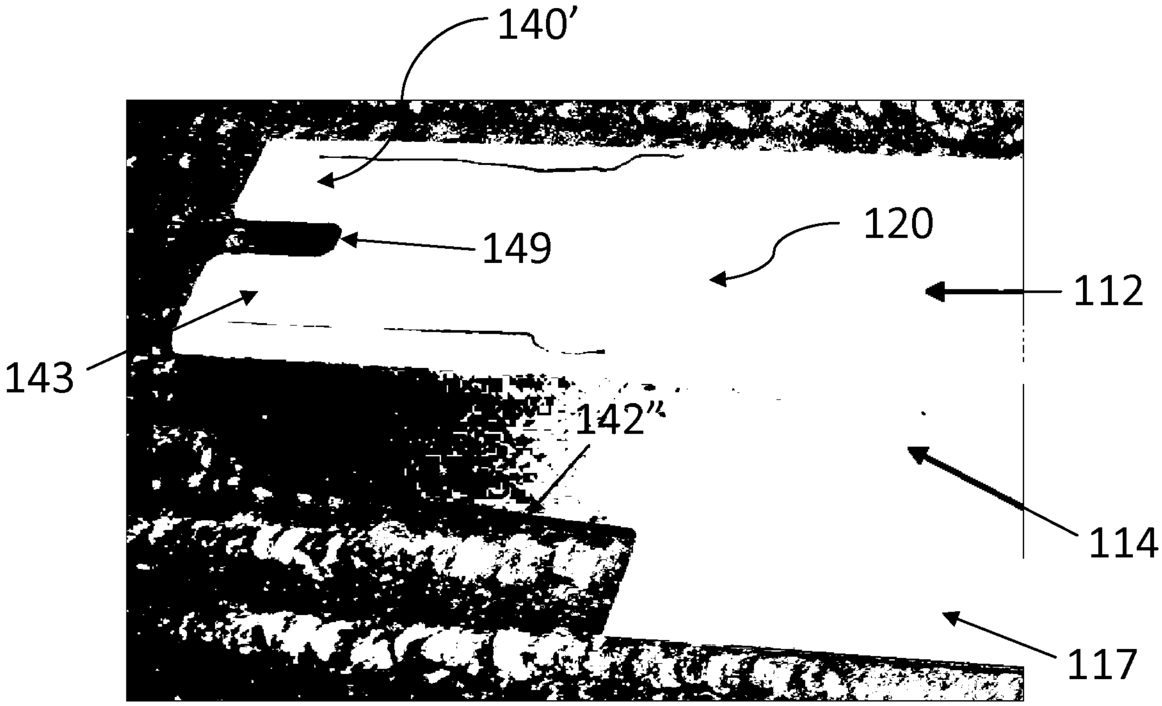

Figure 15B

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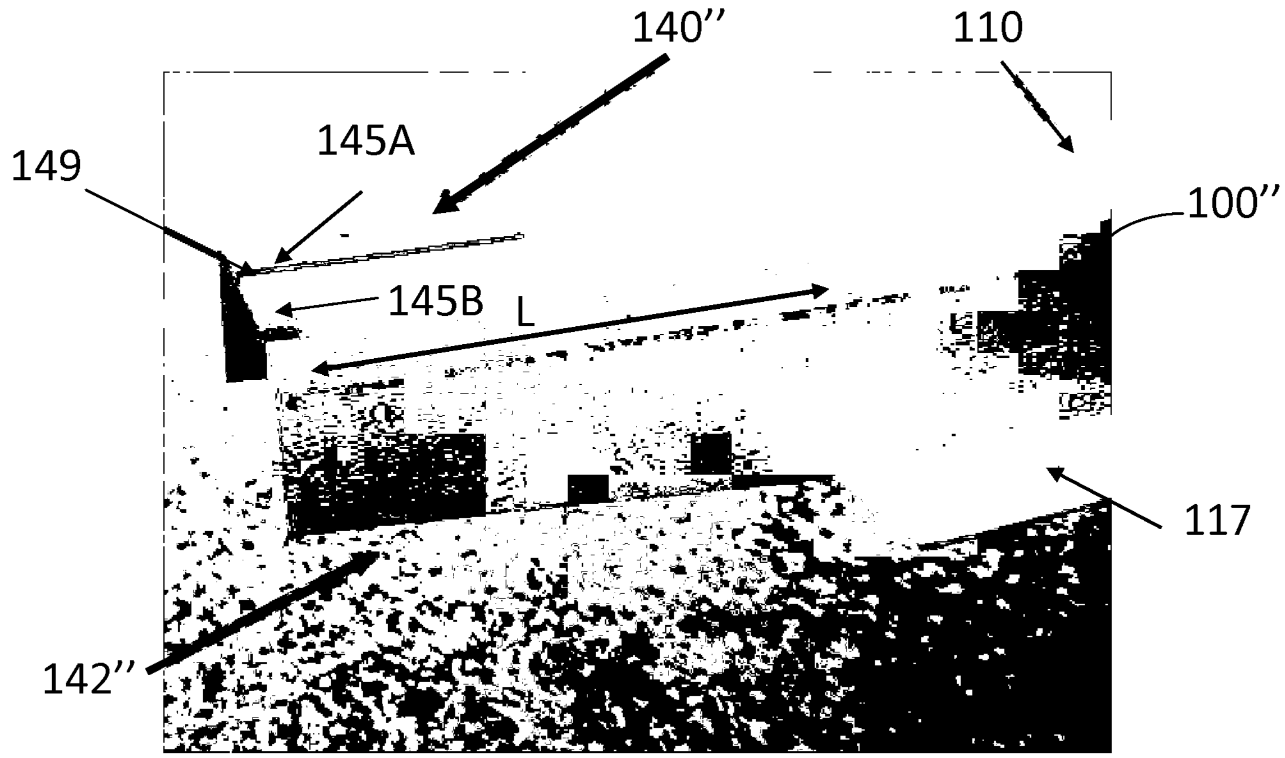

Figure 16

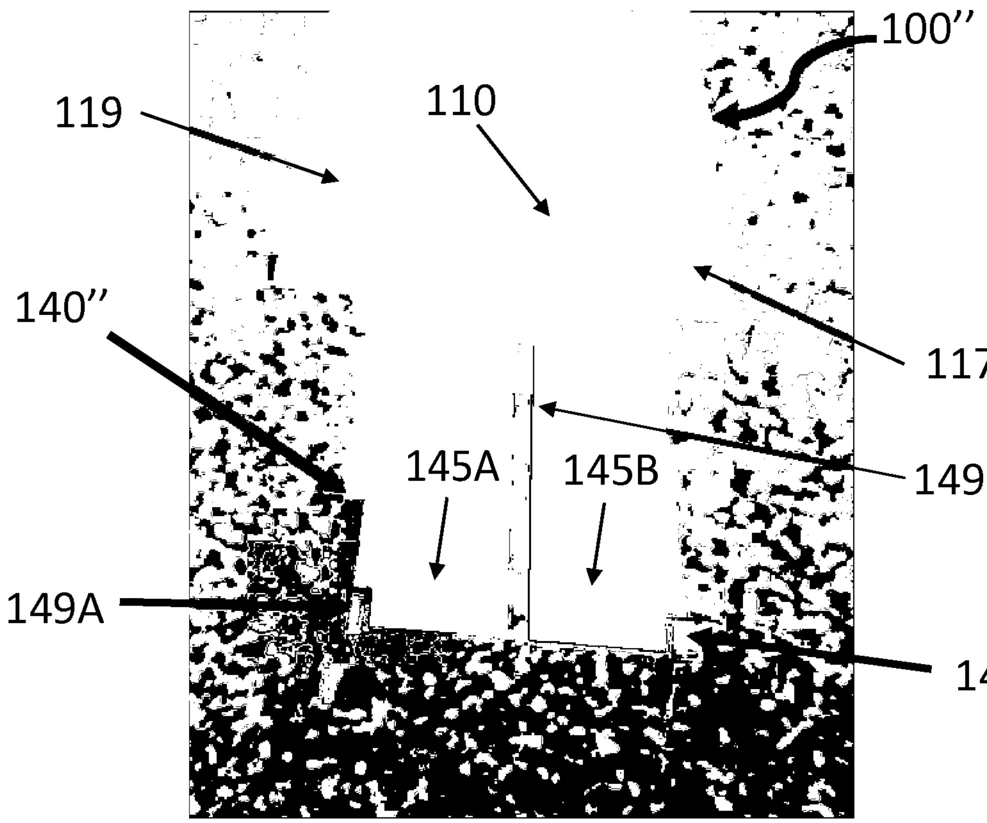

Figure 17

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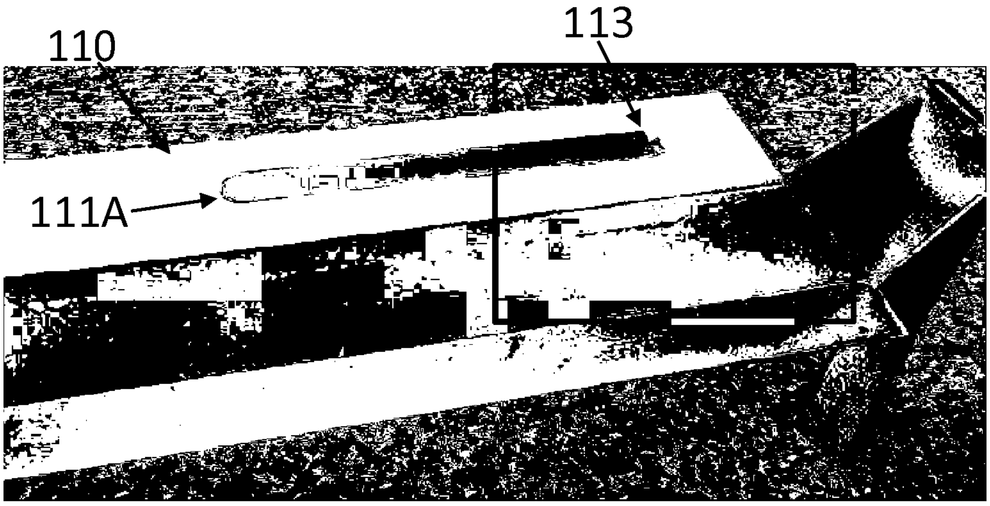

Figure 18

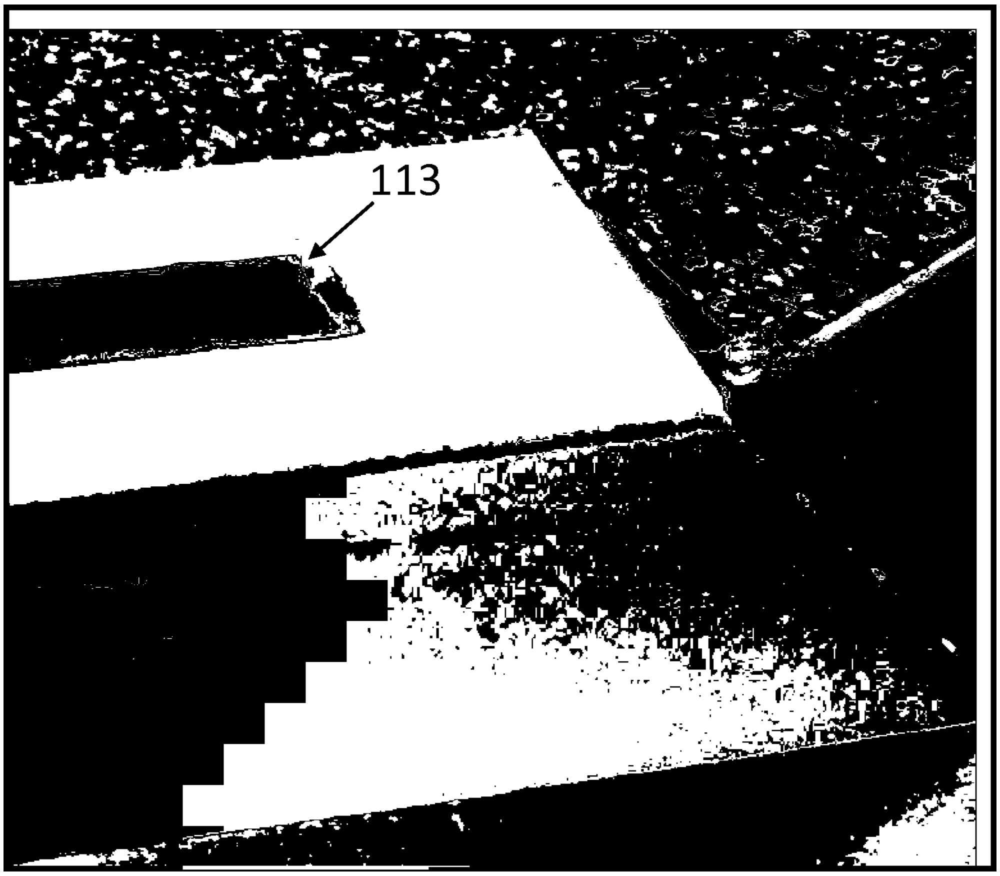

Figure 19

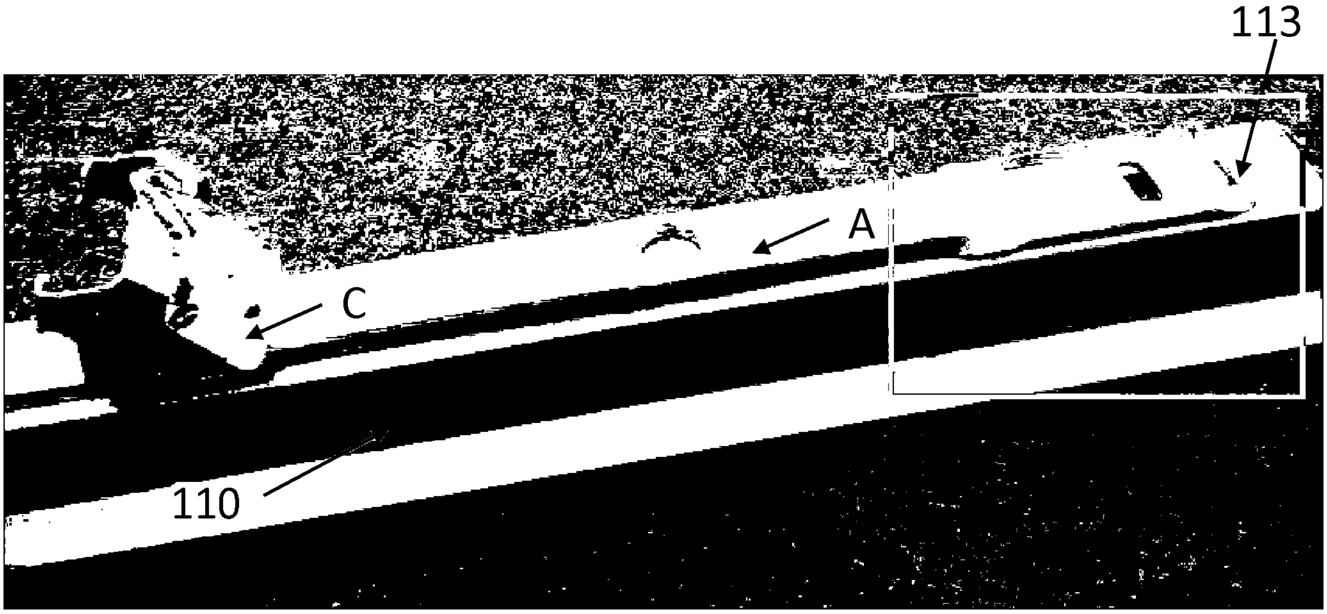

Figure 20

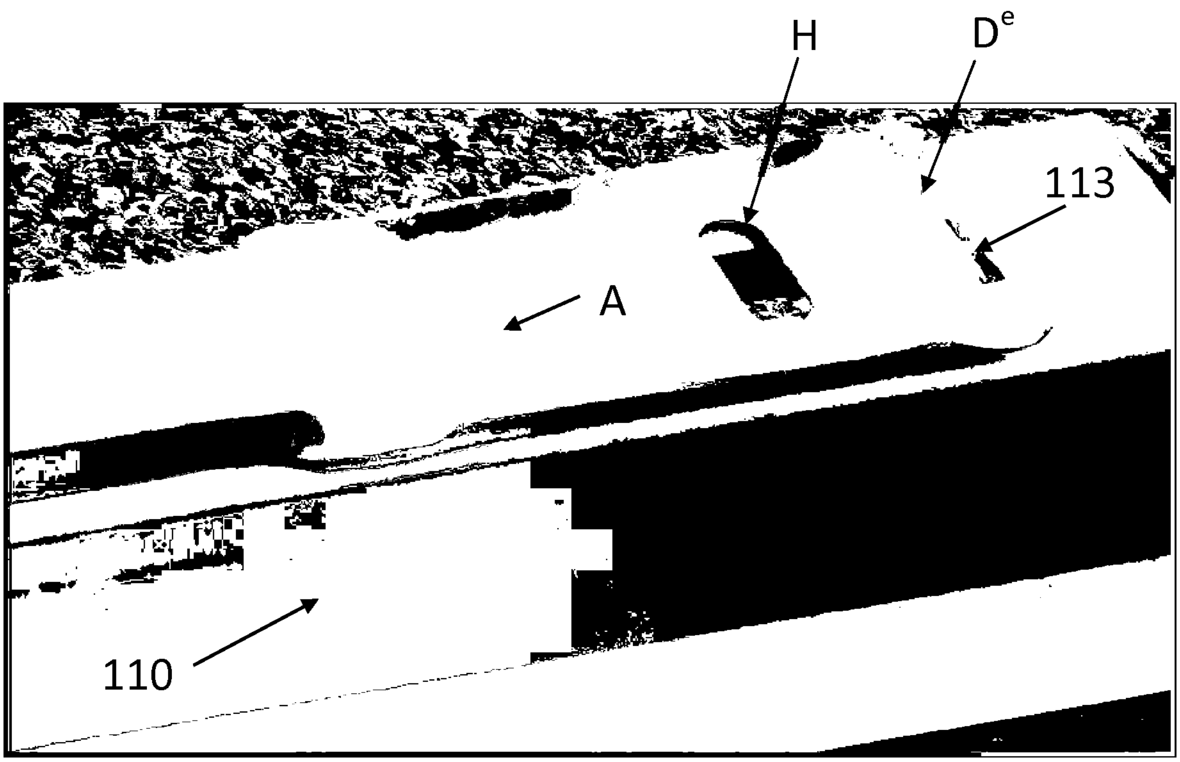

Figure 21

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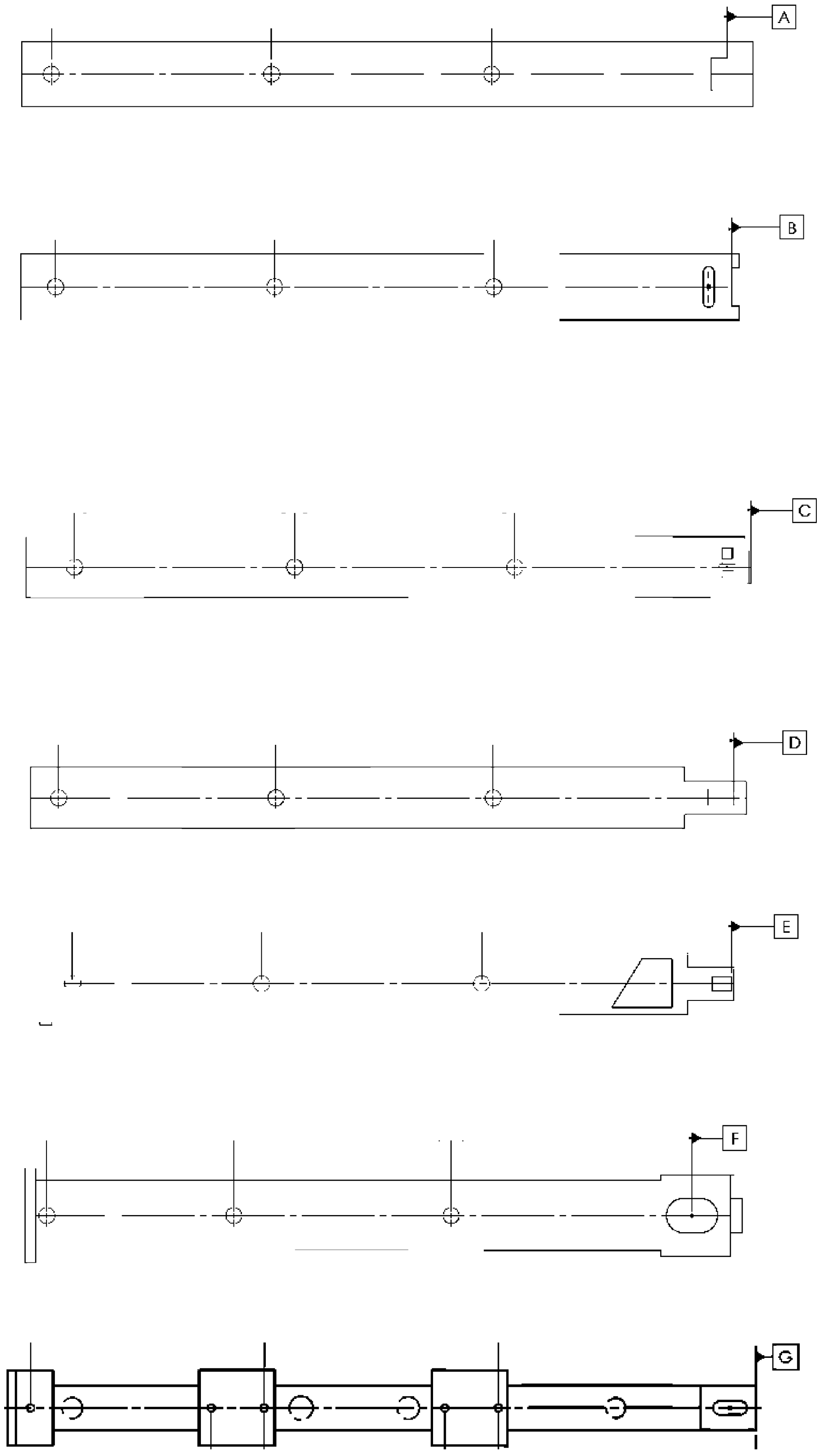

Figure 22

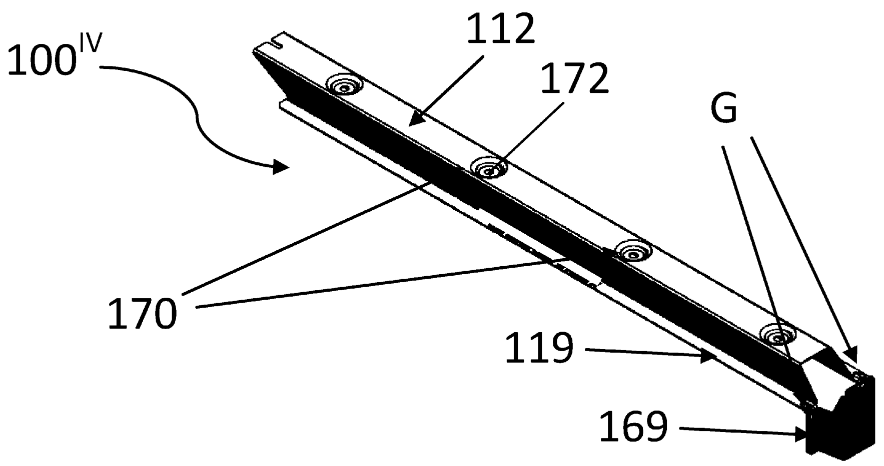

Figure 23

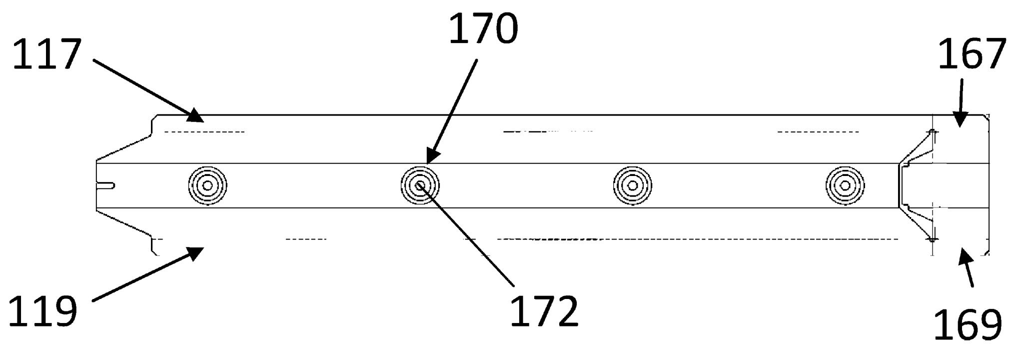

Figure 23A

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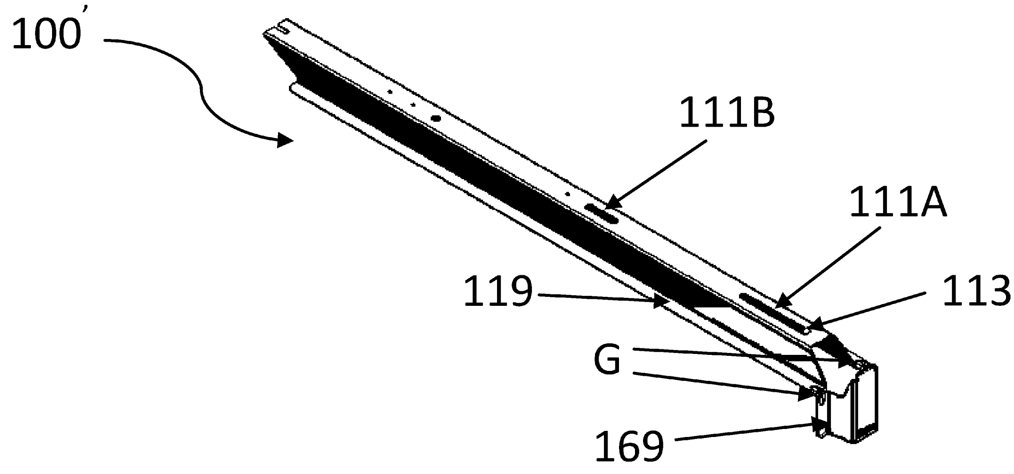

Figure 24

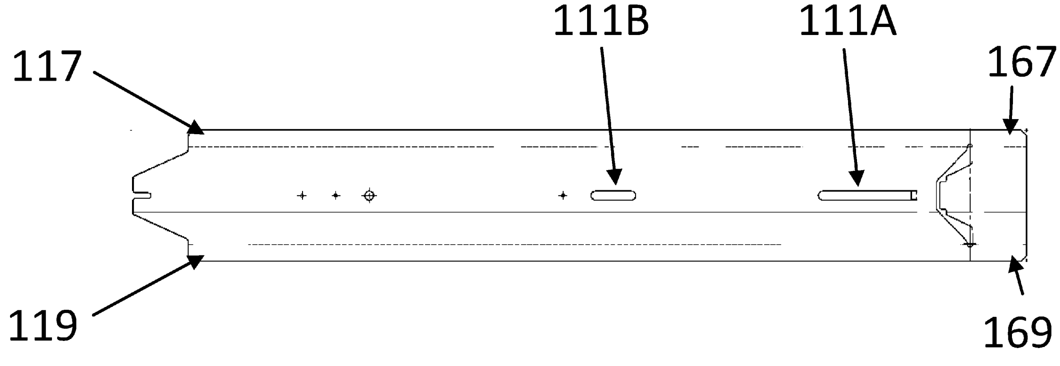

Figure 24A

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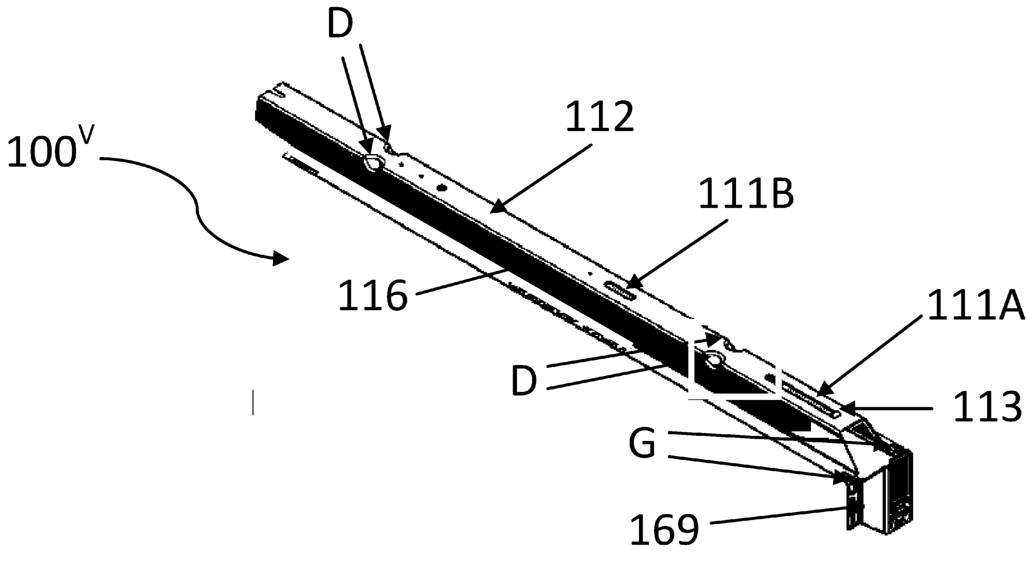

Figure 25

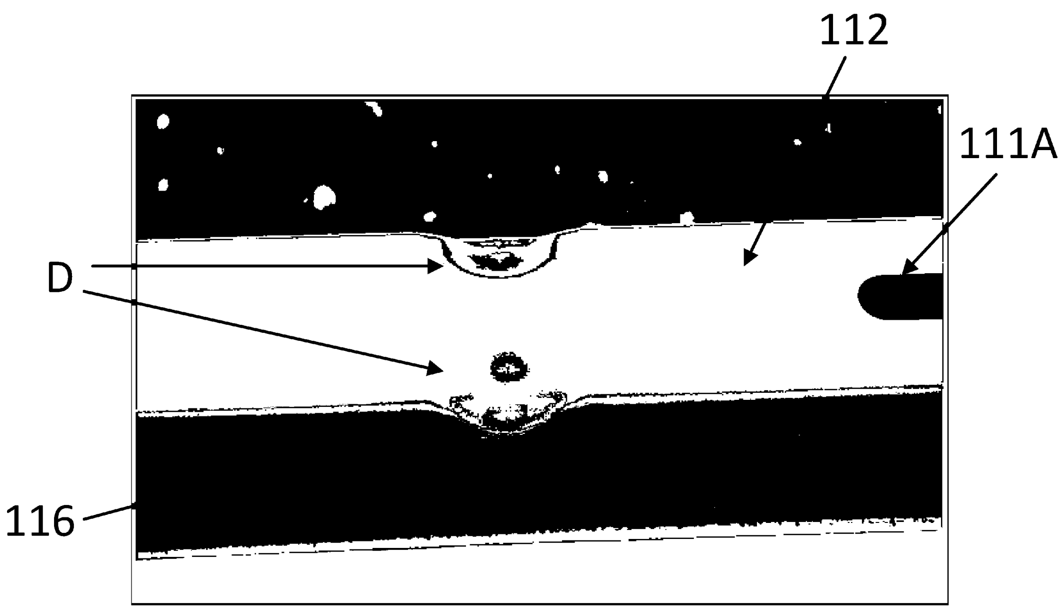

Figure 25A

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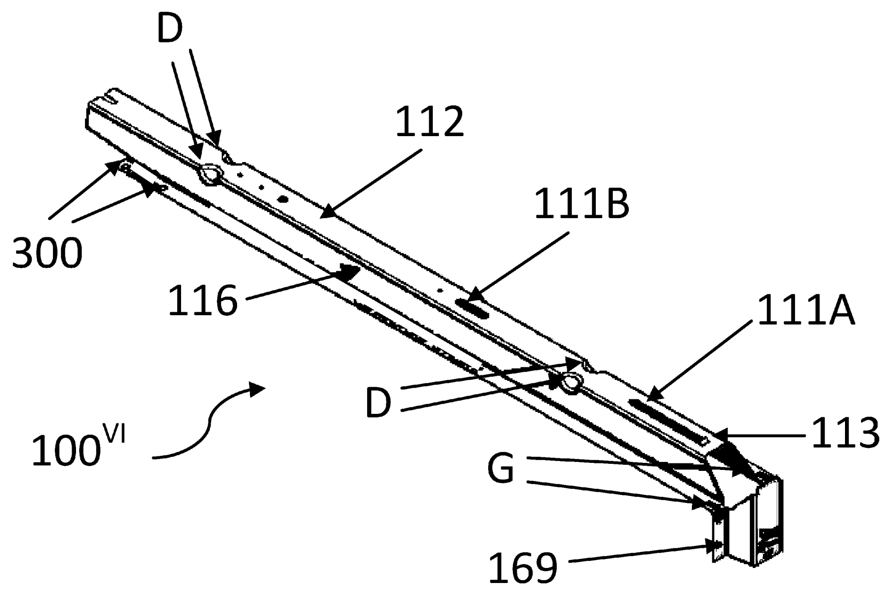

Figure 26

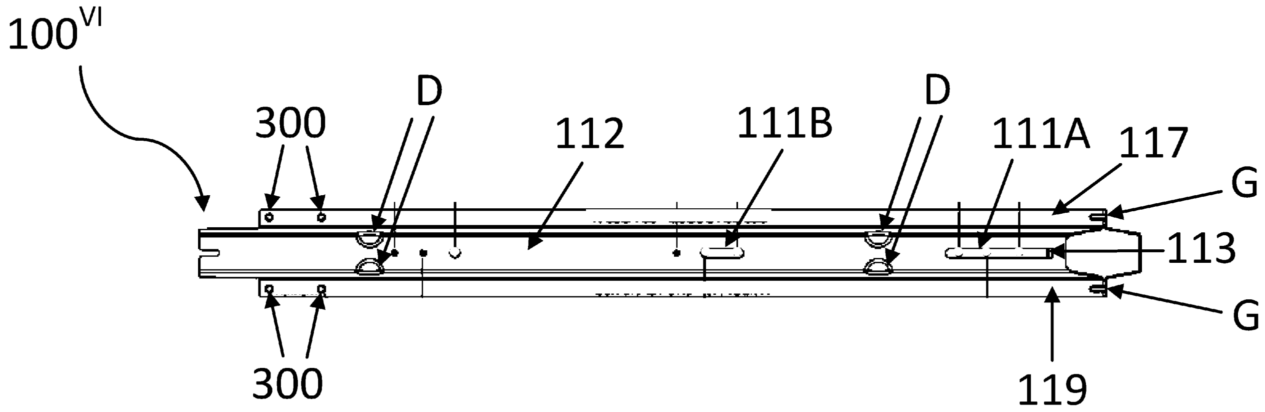

Figure 26A